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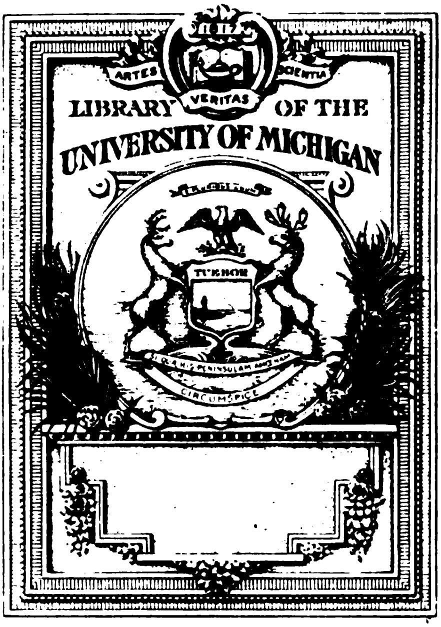
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FOURTH ANNUAL REPORT

OF THE

NEW JERSEY STATE

AGRICULTURAL EXPERIMENT STATION

FOR THE YEAR

1883.

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VINELAND, N. J.:
HENRY W. WILBUR, BOOK AND JOB PRINTER.
1883.

To His Excellency George C. Ludlow, Governor of the State of New Jersey:

Sir—I have the honor to submit herewith the fourth annual report of the New Jersey State Agricultural Experiment Station, as required by the law establishing the Station, which was approved March 10th, 1880, and which is chapter CVI. of the laws of that year.

WILLIAM S. TAYLOR,
Vice-President.

New Brunswick, N. J., December 31st, 1883.

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IRVING S. UPSON, New Brunswick	Clerk.
MISS BELLE PIGOTT, No. 27 Market St., Camden	Attendant at the Branch Office.

TREASURER'S REPORT.

James Neilson, in account with the New Jersey State Agricultural Experiment Station, January 1st, 1883, to January 1st, 1884.

RECEIPTS.

From State Treasurer		$8,306 83

PAYMENTS.

Salaries, and pay of chemists and assistants	$5,693 22	
Expenses of the Board of Managers	127 70	
Stationery, printing and postage	833 61	
Incidentals (including telephone service)	172 00	
Fuel, gas and stoves	127 35	
Laboratory expenses	617 02	
Field and feeding experiments	428 96	
Freight, and traveling expenses in collecting samples of fertilizers	148 17	
Camden Branch Station (not including salary of attendant)	158 80	
		$8,306 83

Respectfully submitted,

JAMES NEILSON,
Treasurer.

NEW BRUNSWICK, N. J., Dec. 31st, 1883.

The subscribers, Auditing Committee, have examined the accounts of the Treasurer and find them correct.

WILLIAM PARRY,
JOHN DEMOTT.

REPORT.

The New Jersey Agricultural Experiment Station herewith presents its fourth annual report. Its objects are, any which are "for the benefit of practical and scientific agriculture, and for the development of our unimproved lands."

A review of the year's work shows that the largest draft upon the resources of the Station has been for the analysis of fertilizers. Experience in the use of chemical manures has gradually led farmers to the firm conclusion that such manures can be used with profit, and still further, that really productive farming cannot be carried on without some enlarged supply of fertilizers. Hence the amount used is increasing with every successive year, and their manufacture ranks among the great industries of the State. An inquiry into the amount consumed in the State in 1882, and which was conducted as carefully as any inquiry into private business can be, gave a return of 30,163 tons, which was worth $1,070,113. This is probably a little short of the true amount of the business, and it does not include the sales of lime, marl and other low-priced fertilizers, nor of the great quantity of manures from the stables and stock-yards of our own and neighboring cities, which are bought and used in our State. In all these there is nothing in their appearance or common properties by which the purchaser can tell whether they are pure or adulterated. He must depend on the integrity of the manufacturer, or the analysis as made by a chemist. It is not surprising that, under these circumstances, farmers should fear that they might not get their money's worth when they purchase fertilizers. As the business of manufacturing gets to be more generally understood, and becomes settled in the hands of responsible men, fertilizers of uniform and good quality are produced. A manufacturer's good name is of value to him, and when he has invested large sums in buildings and stock, which require years of regular business to bring back the money they have cost, he cannot afford to discredit and damage himself by putting inferior articles on the market. And our analyses show that the brands of fertilizers sent out by established and reputable manufacturers, are up to the analyses which they claim for them. The failures which sometimes attend the use of commercial fertilizers may not always be due to their worthlessness, so much as to their not containing a sufficiency of the elements specially needed for a particular crop, or for some variety or condition of soil.

The three substances—potash, phosphoric acid, and nitrogen or ammonia—are the only ones which are likely to be deficient in any soil, or to be needed to increase or perfect crops, and they are the only ones which are valued in a high-priced fertilizer. Each of these has its own peculiar effect on growing crops—in some cases favorably and strongly marked, and in others scarcely perceptible. Manures containing a large amount of nitrogen, have their most marked effect on wheat; those containing a considerable percentage of potash, show the best results on potatoes and on clover, and those containing phosphoric acid, show their good effects upon the growth and maturing of seeds of every kind. In the use of these, the farmer's own skill and experience must guide, and experience gained upon one soil cannot always be transferred to another soil of different quality.

The analyses of various substances containing only one of these manurial elements, which are given in this report, may be used as guides in determining which farmers may find it to their interest to buy; and these materials can either be purchased separately of the dealers, or they can be ordered to be mixed by the manufacturers according to a formula prescribed for them. It is in this direction only that farmers can hope to economize in the use of fertilizers. Manufacturers can select and buy stock for their works at lower prices than farmers can, and with proper power and suitable mills, they can grind bones and rock-phosphates cheaper and better. They can, with mills, sieves and mixing machines, make superphosphates at less cost, and, with machinery adapted to the purpose, they can put fertilizers in better condition for use and quick action, than any unskilled person can hope to.

A review of the field experiments made during the year, in which these fertilizers are tested separately and mixed, will help to enforce the principles stated in the preceding paragraph. They show the benefits of some fertilizers and the failures of others to be of any use. They also show that upon different soils, the same fertilizer may produce very different results. These experiments are by no means complete. They show the necessity for a greater knowledge of the subject in its application to the different kinds of soil in New Jersey. And they also show the great profit which will come to the farmer when he shall be able to order from the manufacturer or dealer what he wishes for his crops, instead of asking from him information as to what it is best for him to buy. This change is gradually taking place, and it is an important part of the Station's work to carry out the experiments which will hasten it forward. And it is further to be hoped that means will be provided for making systematic field experiments with fertilizers in different sections of the State.

In publishing the analyses of fertilizers, we have, as far as possible, brought together those of the same grade in the same bulletin. It seems to be the only way by which the farmer can know of the different brands offered in market, and be guided in the selection of those which will best suit him.

The prices of fertilizers, agreed upon by the Experiment Stations of Connecticut, Massachusetts and New Jersey, are deduced from data which are open to the commercial world, and are believed to be correct. The fluctuations of the market during the year make them, at some times, not closely correct, but they are very nearly so, and, for purposes of ascertaining the comparative values of different kinds on sale, they are fair for the farmer and just to the dealer.

There has been some question among business men as to the justice of publishing the selling prices of the various kinds of manure analyed. There is no doubt as to publishing their values as computed with our prices, and from our analyses; but the prices made by private discounts in lessening, or by the addition of the cost of freight, length of credit, &c., in increasing them are such, in the different cases, as to make it doubtful whether our quoted selling prices are reliable, and, also, whether they do not work to the disadvantage of the best class of purchasers. The publication of selling prices has been abandoned at several of the Stations, and at others it is continued only in cases where there is gross discrepancy between the estimated value and the selling price, or where some comparatively worthless article is offered as a substitute for genuine and well-known fertilizers. By the direction of the Board of Managers the selling prices are omitted from this report.

The feeding experiments, joined to the analyses of fodders and of feeds, are of special interest to stock-growers, dairymen and all economists. The subject is new, and in almost every respect incomplete. But the experiments made prove to a demonstration that we are wasting great quantities of cattle food, such as straw, corn-stalks, etc., which could be profitably used; and that we have in our markets waste products, such as cotton-seed meal, malt screenings, etc., sold at a low price, which are really worth more than many of the farm products which can be sold at a high price. Rations can be made up from these coarse farm products, and the rich waste products, which will be palatable and nutritious, and which will cost far less than those made from good hay and grain. Rations made up in this way are on trial in our feeding experiments, which are given farther on.

It would hardly be worth while to publish such experiments before an extended verification of them has been made, if it were not for the large number of intelligent and skillful stock-growers in New Jersey, who are ready to coöperate in carrying on experiments in this line, if they can have the results of our chemical investigations to aid them in maturing and directing their plans.

Sorghum Sugar and Syrup.—Field and laboratory experiments have been continued this year, and the results, which are given under their appropriate head in this report, bring out strongly some facts in regard to the crop and its working into sugar, which were hardly to be expected. The sorghum was grown on good corn ground, and its cultivation costs but little more than that of Indian corn. Careful extraction made in the laboratory of all the sugar in it indicated a total of 3,963 pounds per acre. On the other hand it is shown that by the ordinary process of grinding and pressing out the juice in mills, only 1,558 pounds of this sugar would be extracted.

This makes a very poor show for the present methods of extracting sugar from the cane; and if manufacturers can live while working in this way, there must be a future of large profits for them, or, what is more likely, one of cheap sugar for consumers. Beet sugar is made from poorer stock than the sorghum is, and yet the beet now furnishes a large portion of all the sugar that is made in the civilized world.

We should do as well here with our sorghum as the people of Europe do with their beets. It is estimated that there are 45,000,000 pounds of sugar consumed in New Jersey every year. It is a fair agricultural and manufacturing product, to which our soil, our climate and our location are suited, and one to which our people should soon become familiarized.

The sugar house at Rio Grande, Cape May county, has been in operation during the season, and is considered to have done a fair business. The sugar company planted 964 acres of sorghum, one-half Early Amber and the other Early Orange, and they have worked up 6,761 tons of cane, and made 282,711 pounds of sugar, and 55,000 gallons of syrup. The crops grown have been satisfactory, and the business appears to be permanently established. There are undoubtedly many economies to be introduced in handling the crop, in extracting the sugar, and in turning all waste products to use.

The enterprise has attracted a great deal of attention. The works have been visited by men from all parts of the Union, and many sugar planters from the South have examined them with interest. There are factories for the making of syrup from sorghum in nearly all the States, and a good quality of the article is made. Larger establishments for making sugar have been in operation in Champaign, Illinois, and in Ottowa and Sterling, Kansas, and they are said to have succeeded well. The season has been much shorter and cooler than the average, and the crop has not been up to what may be calculated on in ordinary seasons.

As a forage crop, too, sorghum possesses some advantages. Its weight is about equal to that of Indian corn, and when cut and crushed for green fodder it is eaten with great avidity. It stands dry weather better than most other crops. The seed is a valuable part of the crop—in quality it is equal to Indian corn; and the yield on our experiment plots, this year, was 32 bushels per acre.

Ensilage.—Our experiments with ensilage are still in progress. Our results agree with those reached by so many others, in the conclusion that ensilage is a wholesome and nutritious food. Milk from our dairy, and produced from cows fed daily upon ensilage, has been uniformly satisfactory in quality to the numerous customers who have taken it.

In comparing it as a food with ordinary dry fodder, we have not found ensilaged fodder corn to be any more nutritious for milch cows than an equivalent amount of fodder corn cured in the ordinary way, and cut up fine, so as to be fed the same as ensilaged fodder corn.

In the like samples of ensilaged and dried fodder corn, which were analyzed when first taken from the field, and again analyzed after each of them had been preserved and kept in the usual way till the time for feeding, late in the winter, there was no more loss in the dried sample than in the ensilaged one.

We have now in progress experiments on the expense and nutritive value of ensilaged fodder corn, compared with matured corn and corn stalks grown in the common way, on the same area of equally good ground. These experiments will be carried through in the course of the winter.

Milk.—The purity and good quality of milk is a question of great interest in the agricultural community as well as in cities and towns, where the supply has to be bought in market. Common honesty as well as the health of the most helpless portion of community requires that unadulterated milk should be sold, and, at the same time, proper allowance must be made for those variations in the quality of milk which come with the changes of food or of weather, or with the period of lactation, or those which are peculiar and natural to different animals, or to different breeds.

The law of the State requires that milk shall contain at least 12 per cent. of total solids. A trial has been made of average samples of milk from each of twelve dairies, once a month during the whole of the last year. .The details of these trials are given further on in this report. The average for the year in every one of the herds is considerably above 12 per cent., though six samples, out of the one hundred and forty tested, have fallen a little below the standard.

Sweet-Potato-Sick Soils.—An interesting experiment has been made during the past season to find some cure for the sweet-potato rot which affects this crop on some soils where they have been grown for a great many successive years. The experiment was conducted at our request by Mr. Josiah Budd, at Thoroughfare, Gloucester county, on ground that was badly affected by this sweet-potato sickness four or five years ago, when it was last planted for that crop. The experiment was directed so as, without interfering with the ordinary successful growing of the crop, to add some fertilizer in which the soil may be deficient, and possibly to produce some effect on any vegetable or animal growth in the soil which may be destructive to the sweet-potato.

The results of the experiment are encouraging, though not decisive. They are given below. Another year we hope to have the fertilizers spread broadcast over the ground some time before the season comes for planting, and then to make a second application in the hills at the time of planting, and three different farmers have begun the work for such trials.

Bulletins.—The results of our work have been circulated among the farmers of the State, in bulletins, which have been issued as often as any class of analyses has been completed. The list of farmers to whom the bulletins are sent now numbers something over 5,000. It should be still further increased, and we add names to the list as fast as we can devise ways of ascertaining those to whom they will be useful. This work of sending out the bulletins directly to the farmers, is the effective way of producing the results for which the Station was established. No amount of good work in the laboratory or field will avail unless it is brought to the knowledge of those who are to apply its results in practical life. The agency of the press is necessary and must be used. The mode of distribution has met the hearty approval of every one. And to us who are in the Station there is a well-marked advancement shown by farmers in their understanding and applying the principles of science to their farming operations.

RECORD OF WORK COMPLETED.

I. ANALYSES.

1. Fertilizers—194 samples.
2. Fodders and Feeds—40 samples.
3. Milk, total solids—140 samples.

II. FEEDING EXPERIMENTS.

1. Green Rye.
2. Rye Ensilage.
3. Dried Fodder-Corn.
4. Corn Ensilage.

III. FIELD TRIALS WITH FERTILIZERS.

1. On Corn, Wheat, Potatoes, Sorghum, Sweet-Potatoes, and Clover.

IV. SORGHUM AS A SOURCE OF CANE SUGAR.

V. PRELIMINARY WORK ON SWEET-POTATO DISEASE.

RECORD OF WORK IN PROGRESS.

I. ENSILAGE.

1. Value of Green Fodder-Corn stored as Ensilage compared with value of Crop of Field-Corn, including both Corn-Meal and Dried Stalks.
2. Comparison between Corn Ensilage cut one-half inch, and Corn-Ensilage one-quarter inch.
3. Sorghum as Ensilage; including loss of Sugar in Silo, and attempts to prevent this loss by means of Calcium Bisulphite.
4. Field-Corn Stalks cut and packed as Ensilage.
5. Value of Clover Ensilage.
6. Attempt to Improve the Quality of Green Rye, too Tough for Soiling, by Changing it into Ensilage.
7. Ensilaged Brewers' Grains.

II. FEEDING EXPERIMENTS.

1. Dried Brewers' Grains Compared with Ensilaged Grains.
2. New Process Oil-Meal Compared with Ground Oil-Cake.

III. FIELD EXPERIMENTS WITH FERTILIZERS.

1. Action of Wool Waste on Wheat.
2. Action of Wool Waste, Decomposed with Caustic Potash, on Wheat.

IV. BARN-YARD MANURE.

1. Amount of Nitrogen, Phosphoric Acid and Potash in Manure, Compared with Amount in Food Eaten.
2. Loss of Nitrogen and Potash when Manure is Exposed to Weather.

BULLETINS ISSUED DURING THE YEAR.

Station No.

27. Prices of Nitrogen, Phosphoric Acid and Potash, and Analysis of Incomplete Fertilizers, April 21st, 1883.

28. Analyses and Valuations of Complete Manures and Special Fertilizers, July 2d, 1883.

29. Analyses and Valuations of Nitrogenous Superphosphates, Ground Bones, Plain Superphosphates, Poudrettes and Miscellaneous Fertilizers, August 2d, 1883.

30. Results of Field and Laboratory Experiments with Sorghum for the Season of 1883, November 16th, 1883.

31. Nitrate of Soda, or Chili Saltpetre as a Top Dressing for Wheat, December 22d, 1883.

The results of the Station's work during the year are arranged in order, as follows:

FERTILIZERS.

I. Commercial Relations.

Statistics of consumption in New Jersey.
Quotations of wholesale prices of nitrogen and potash in 1883.
Prices of nitrogen, phosphoric acid and potash used in estimating the prices of fertilizers in 1883.
Analyses of stock used in making fertilizers.
" " complete fertilizers.
" " ground bones.
" " nitrogenous superphosphates.
" " miscellaneous fertilizers.

II. Agricultural Relations.

Field trials of fertilizers on Indian corn.
" " " " potatoes.
" " " " wheat.
" " " " clover.
" " " " sorghum.
" " " " sweet potatoes.

FODDERS AND FEEDS.

Analyses of fodders, feeds.
Feeding trials with rye ensilage and green rye.
" " " corn " " " corn.

MILK.

Series of experiments on total solids in milk.

MISCELLANEOUS.

Cow-peas, tobacco, cotton, etc.

FERTILIZERS.

The work of the Station, in regard to fertilizers, divides itself into two parts:

I. To ascertain the commercial relations of fertilizers, their production and cost, as articles of merchandise.

II. To show their agricultural relations—that is, their value to the farmer as the means for increasing his crops.

I.

STATISTICS OF SALES OF FERTILIZERS CONSUMED IN NEW JERSEY DURING THE YEAR ENDING DEC. 31, 1882.

These statistics were taken by manufacturers from their books in answer to request made by this Station. The reports were in each case returned on printed forms, of which the following is a copy:

SALES OF COMMERCIAL FERTILIZERS.

The following is a correct statement of the number of tons of the several classes of Commercial Fertilizers sold in New Jersey by..during the year ending December 31st, 1882:

Number of tons of Complete Manure..
" " Ammoniated Superphosphate without Potash (Dissolved Bone, etc.)..
" " Ground Bone..
" " Kainite..
" " Muriate of Potash..
" " Nitrogenous Matter..
(*a*) Ammonium Sulphate..
(*b*) Sodium Nitrate..
(*c*) Blood, Ammonite, etc..
Number of tons of Plain Superphosphates, including both Dissolved Bone Black and S. C. Acid Phosphate..

Two manufacturers paid no attention to the request for statistics; three, for business reasons, declined to make returns. Thirty-three manufacturers reported that their sales in New Jersey amounted to 30,163 tons, divided as follows:

Number of tons of Complete Manure	15,941
" " Ammoniated Superphosphate without Potash (Dissolved Bone, etc.)	1,370
" " Ground Bone	2,509
" " Kainite	683
" " Muriate of Potash	144
" " Ammonite	719
" " Ammonium Sulphate	76
" " Sodium Nitrate	26
" " Blood	244
" " Fish	228
" " Hair	248
" " Poudrette	3,450
" " Superphosphates, 30–40 per cent	562
" " " 11–18 "	3,963

The annual report of this Station for the year 1882 shows that the average retail prices for that year were as follows:

Complete Manure	$41 00	per ton.
Ammoniated Superphosphate without Potash (Dissolved Bone, etc.)	32 00	"
Ground Bone	37 00	"
Kainite	12 00	"
Muriate of Potash	41 00	"
Ammonite	56 00	"
Ammonium Sulphate	99 00	"
Sodium Nitrate	76 00	"
Blood	56 00	"
Fish	45 00	"
Hair	10 00	"
Poudrette	10 00	"
Superphosphates with 30 to 40 per cent	75 00	"
" " 11 to 18 "	28 50	"

Calculated from the above data, the total value of commercial fertilizers sold during the year was *one million and seventy thousand one hundred and thirteen dollars* ($1,070,113). This does not include marl, lime, plaster, or barn-yard and stable manure.

Wholesale Prices at New York During the Year 1883.

MONTHS.	Cost per Pound of Nitrogen, in Form of—								Cost per Pound of Potash in—			
	Nitrate of Soda.		Sulphate of Ammonia.		Azotine.		Dried Blood.		Muriate of Potash.		Kainite.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
January	18.0c	16.6c	21.4c	20.8c	20.5c	19.7c	19.7c	....	3.6c	3.5c	4.0c	3.4c
February	18.0	16.0	21.4	20.8	19.	19.	18.2	....	3.6	3.5	4.1	3.0
March	18.0	16.0	20.2	19.0	19.	....	18.2	17.5 c	3.6	3.3	3.3	3.0
April	18.0	16.0	20.2	19.0	19.	....	18.2	17.5	3.3	3.3	3.5	2.9
May	16.25	15.0	20.2	19.0	19.	18.2	19.	17.5	4.3	3.2	3.3	2.9
June	16.25	14.7	20.2	18.4	18.2	....	18.2	17.5	3.5	3.3	3.5	2.9
July	15.6	14.1	19.	16.7	18.9	....	17.5	17.5	3.4	3.1	3.5	3.0
August	15.3	14.1	19.	16.7	18.9	....	15.9	15.2	3.3	3.1	3.3	3.1
September	15.0	13.9	17.2	16.7	18.9	15.2	15.2	14.3	3.3	3.2	3.3	3.2
October	15.0	13.75	17.2	16.7	15.2	....	15.2	14.3	3.3	3.0	3.3	3.3
November	15.0	13.75	17.2	16.7	15.2	....	15.2	13.6	3.3	3.0	3.3	3.3
December	14.7	13.44	17.4	15.5	13.6	12.9	15.2	13.6	3.3	3.1	3.9	3.3

At a meeting held in New Haven on the third of March, 1883, the Directors and Chemists of the Experiment Stations of Connecticut, Massachusetts and New Jersey agreed upon a schedule of prices to be used during the year in computing the *relative commercial values* of fertilizers. The lists used for this purpose in 1881 and 1882 are republished for convenience of reference:

	Cents per lb. 1881.	Cents per lb. 1882.	Cents per lb. 1883.
Nitrogen in nitrates	26	26	20
" in ammonia salts	22½	29	26
" in Peruvian guano, fine steamed bone, dried and fine ground blood, meat and fish, superphosphates and special manures	20	24	23
" in coarse or moist blood, meat or tankage, cotton seed, linseed and castor pomace	16	18	18
" in fine ground bone, horn and wool dust	15	17	17
" in fine medium bone	14	15	15
" in medium bone	13	14	14
" in coarse medium bone	12	13	13
" in coarse bone, horn shavings, hair and fish scrap	11	11	11
Phosphoric acid soluble in water	12½	12½	11
" " "reverted" and in Peruvian guano	9	9	8

	Cents per lb.		
	1881.	1882.	1883.
Phosphoric acid insoluble, in fine bone, fish guano and superphosphates	6	6	6
" " " in fine medium bone	5½	5½	5½
" " " in medium bone	5	5	5
" " " in coarse medium bone	4¼	4¼	4¼
" " " in coarse bone, bone ash and bone black	4	4	4
" " " in fine ground rock phosphate	3½	3	2¾
Potash in high grade sulphate	7½	7	7
" in low grade sulphate and kainite	5½	5	4¼
" in muriate or potassium chloride	4½	5	4¼

The *actual commercial value* of a high-priced fertilizer depends, first, upon the quality and quantity of the nitrogen, phosphoric acid and potash which it contains; and, second, upon the wholesale market prices of these three elements, at the time of the sale.

The first point can be approximately settled by chemical analysis, and, when once settled, it is not liable to fluctuations. The second point depends entirely upon *supply and demand*; factors subject at all times to marked variations. The *actual commercial values* of fertilizers must vary, therefore, with the supply and the demand for nitrogen, phosphoric acid and potash.

The *relative commercial values* of fertilizers depend, first, upon the quantity and quality of the nitrogen, phosphoric acid and potash which they contain; and, second, upon the schedule of prices adopted by Station officials. These schedules are corrected once only each year; *relative commercial values*, therefore, are not subject to fluctuations.

The prices which farmers pay for fertilizers should be deduced from their *actual commercial values*. If this were done, the relative commercial values assumed by Stations could be dropped and the duties of these institutions could then be limited to ascertaining whether manufacturers kept the guarantees which the State law obliges them to publish.

The fact, however, that guarantees and retail prices, particularly of complete manures, remain unchanged year after year, instead of varying, from month to month, in sympathy with the wholesale market, indicates that these prices are now fixed with but little reference to any uniform standard.

It is not intended that *relative commercial values* shall in any way interfere with legitimate business; their province is to check or expose extortionate charges and to furnish a ready means for comparing various brands of fertilizers with each other. Their utility will depend largely upon their agreement with the average retail prices used by reputable manufacturers.

To obtain these average prices, the Station found it necessary to secure and analyze samples of nitrogenous matter, of phosphatic material, and of salts valued as fertilizers solely on their percentages of potash. Manufacturers, from whose stocks these samples were taken, furnished the Station with the retail cash prices ruling on the first of April, 1883. These data were sufficient for compiling the following:

MANUFACTURERS' AVERAGE RETAIL CASH PRICES FOR APRIL 1, 1883.

	Cost, Cents per lb.
Nitrogen from nitrate of soda	19.65
" " sulphate of ammonia	20.78
" " dried blood	21.10
" " dried fish	17.50
" " ammonite or dried flesh	20.60
" " cotton-seed meal	18.60
Soluble phosphoric acid from S. C. rock	9.99
" " " " bone black	8.97
Reverted " " " S. C. rock	7.26
" " " " bone black	6.52
Insoluble " " " S. C. rock	2.58
" " " " bone black	3.26
Potash in high grade sulphate	7.17
" kainite	4.52
" muriate	4.15

The comparison between this schedule and the preceding one shows that all marked differences are in favor of the manufacturers, their selling prices being lower than the Station's assumed rates.

The table, on a preceding page, giving average monthly quotations of wholesale prices, indicates that since April the market value of fertilizing material, at commercial centers, has been gradually falling; consequently the *relative valuations* of this Station have been, throughout the year, higher than the actual retail prices at points of shipment.

In the case of complete fertilizers, therefore, whatever amounts have been paid by farmers in excess of Station valuations, must be charged to cost of mixing, to freight, to credits and to expenses of retailing, which includes, of course, the profits to middlemen.

The analyses and valuations of samples, on which the above price list depends, can be found on the following pages.

The prices of phosphoric acid, particularly from South Carolina rock phosphate, were somewhat increased by samples received subsequent to April 1st.

NITRATE OF SODA—*Furnishing Nitrogen in the Form of Nitrates.*

NAME AND ADDRESS OF DEALER.	Station No.	Pounds of Nitrogen in 100 lbs. of Nitrate of Soda.	Cost of Nitrogen per pound.	Cost of Nitrate of Soda per ton.
U. S. Chemical Co., Camden	479	16.28	18.40c	$60.00
Lister Bros., Newark	488	15.77	19.00	60.00
Geo. B. Forrester. New York	465	16.23	19.25	62.50
Mapes F. & P. Guano Co., New York	426	16.01	19.50	62.50
Harrison Bros., Philadelphia (1)	428	15.97	20.3	65.00
Bowker Fertilizer Co., New York	449	15.84	20.50	65.00
H. J. Baker Bros., New York	471	15.75	20.60	65.00
Average Cost per pound of Nitrogen			**19.65c**	
Moro Phillips, Camden	490	16.08	23.3	75.00
Baugh & Sons, Philadelphia	506	15.88	25.2	80.00

SULPHATE OF AMMONIA—*Furnishing Nitrogen in the Form of Ammonia.*

NAME AND ADDRESS OF DEALER.	Station No.	Pounds of Nitrogen in 100 lbs. of Sulphate of Ammonia.	Cost of Nitrogen per pound.	Cost of Sulphate of Ammonia per ton.
Lister Bros., Newark	437	20.89	19.75c	$82.50
Mapes F. and P. Guano Co., New York	432	21.02	20.2	85.10
Geo. B. Forrester, New York	468	21.16	20.6	87.50
H. J. Baker Bros., New York	470	21.19	20.7	88.00
Baugh & Sons, Philadelphia	505	20.45	20.8	85.00
Harrison Bros., Philadelphia (1)	422	21.11	21.3	90.00
Williams, Clark & Co., New York	444	21.02	21.4	90.00
Bowker Fertilizer Co., New York	452	20.92	21.5	90.00
Average Cost of Nitrogen per pound			**20.78c**	

DRIED BLOOD—*Furnishing Nitrogen in the Form of Organic Matter.*

NAME AND ADDRESS OF DEALER.	Station No.	Pounds of Nitrogen in 100 lbs. of Blood.	Cost of Nitrogen per pound.	Cost of Dried Blood per ton.
M. L. Shoemaker & Co., Philadelphia	503	13.82	18.8c	$52.00
Lister Bros., Newark	439	13.88	18.9	52.50
Williams, Clark & Co., New York	443	7.88	22.2	35.00
Mapes F. and P. Guano Co	427	11.05	22.6	50.00
Bowker Fertilizer Co., New York	451	9.17	22.9	42.00
Average Cost of Nitrogen per pound			**21.1c**	

(1) Sampled by Charles Collins, Fellowship, N. J.

AMMONITE, AZOTINE, Etc.—*Furnishing Nitrogen in the Form of Organic Matter.*

NAME AND ADDRESS OF DEALER.	Station No.	Pounds per hundred		Cost per pound.		Cost of Ammonite, etc., per ton.
		Nitrogen.	Phosphoric Acid.	Nitrogen.	Phosphoric Acid.	
M. L. Shoemaker. Philadelphia, Ammonite B.	501	12.14	2.96	19.9c	6c	$52.00
U. S. Chemical Co., Camden, Ammonite B. (1)	478	11.78	2.82	20.	6	*50.00
Wm. Shivers, Philadelphia, Animal Matter (2)	414	9.55	2.20	20.6	6	42.00
Moro Phillips, Philadelphia, Ammonite	495	11.76	3.01	21.2	6	53.50
Baugh & Sons, Philadelphia, A. A. Nitrogen	507	10.07	4.15	21.3	6	48.00
Average Cost of Nitrogen per pound	....	....	....	20.6c	....	....
M. L. Shoemaker, Swift Sure Guano	499	6.52	13.27	18.9c	6c	40.00
Philadelphia Stock Yard Company's Blood Fertilizer, (3)	519	7.21	.83	27.	6	40.00

DRIED FISH.

NAME AND ADDRESS OF DEALER.	Station No.	Pounds per hundred		Cost per pound.		Cost of Dried Fish per ton.
		Nitrogen.	Phosphoric Acid.	Nitrogen.	Phosphoric Acid.	
Lister Bros., Newark	436	8.60	6.92	15.5c	6c	$35.00
Williams, Clark & Co., New York	445	8.34	7.60	18.5	6	40.00
Bowker Fertilizer Co., New York	453	8.59	6.84	18.5	6	40.00
Average Cost of Nitrogen per pound	....	....	....	17.5c	....	....

COTTON-SEED MEAL AND CASTOR POMACE.

NAME AND ADDRESS OF DEALER.	Station No.	Pounds per hundred		Cost per pound.		Cost of Pomace and Meal per ton.
		Nitrogen.	Phosphoric Acid.	Nitrogen.	Phosphoric Acid.	
Cotton S. Meal, Taylor Bros, Camden	410	6.81	3.56	18.6c	6c	$30.00
Castor Pomace, H. J. Baker Bros., New York	472	5.05	1.97	21.4	6	24 00
Average Cost of Nitrogen per pound	....	....	....	20.0c	....	....

*(1) In 10 ton lots.

(2) Sampled by S. L. Borrough, Merchantville.

(3) Sampled by Hon. Thos. H. Dudley, Camden.

PLAIN SUPERPHOSPHATES, From South Carolina Rock, Etc.

Station No.	BRAND.	MANUFACTURER.	SAMPLED BY.
568	Concentrated Superphosphate	Sold by H. J. Baker & Bro.	Chemist of Station.
467	English Superphosphate	Baker Bros., New York.	" "
440	Dissolved S. C. Rock	Williams, Clark & Co., N. Y.	" "
523	Acid Phosphate	Atlantic & Virginia Fert. Co., L. I.	L. D. Cook, Bound Brook.
420	" "	Harrison Bros., Phila.	C. Collins, Fellowship, N. J.
455	Dissolved S. C. Rock	Bowker Fert. Co., Elizabeth.	Chemist of Station.
492	Soluble Bone	Moro Philips, Camden.	" "
518	Acid Phosphate	Sharpless & Carpenter, Phila.	A. Newbold, Bordentown, N. J.
592	English Superphosphate	Sold by Wilson, Fitzgerald & Co.	Vanburen Giffin, Kirkwood, N. J.
591	" "	" " " "	S. L. Borrough, Merchantville, N. J.
425	Dissolved S. C. Rock	Mapes F. & P. Guano Co., N. Y.	Chemist of Station.
521	Diamond Soluble Bone	Walton, Whann & Co., Wil., Del.	J. Bergen Thompson.
544	Acid Phosphate	E. Frank Coe.	David C. Voorhees.
602	Diamond Soluble Bone	Walton, Whann & Co., Del.	Amos Ebert.
484	Philadelphia Standard	U. S. Chemical Co., Camden.	Chemist of Station.
515	Acid Phosphate	J. B. Sardy & Sons, N. Y.	Theodore Beakman.
487	Acidulated Phosphate	New Jersey Chem. Co., Camden.	Chemist of Station.

PLAIN SUPERPHOSPHATES, From Bone Black, Etc.

Station No.	BRAND.	MANUFACTURER.	SAMPLED BY.
488	Bone Black Superphosphate.	Lister Bros., Newark, N. J.	Chemist of Station.
468	" " "	H. J. Baker Bros., N. Y.	" "
541	" " "	Lister Bros., Newark, N. J.	Stephen C. Dayton, Basking Ridge.
454	Dissolved Bone Black	Bowker Fert. Co., N. Y.	Chemist of Station.
462	Bone Black Superphosphate.	Geo. B. Forrester, N. Y.	" "
481	" " "	Mapes F. & P. Guano Co., N. Y.	" "
424	High Grade Superphosphate.	" " " " "	" "

PLAIN SUPERPHOSPHATES, From South Carolina Rock, Etc.

Furnishing Soluble, Reverted and Insoluble Phosphoric Acid.

Station No.	NAME AND ADDRESS OF DEALER.	Pounds per 100.			Cost per Pound.			Cost per Ton of Superphosphates.	Estimated Price per Ton.
		Phosphoric Acid soluble in Water.	Phosphoric Acid soluble in Am. Cit.	Insoluble Phosphoric Acid.	Phosphoric Acid soluble in Water.	Phosphoric Acid soluble in Am. Cit.	Insoluble Phosphoric Acid.		
568	Packards, Ipswich, England.......	36.76	7.49	0.79	9.14c	6.65c	2.28c	$77.50	$93.28
467	H. J. Baker Bros., New York	19.14	0.74	1.19	8.24	5.99	2 06	33.00	43.94
440	Williams, Clark & Co., New York	11.57	1.87	2.18	9.28	6.75	2.82	25.00	29.64
523	Atlantic and Virginia Fert. Co...	9.38	3.29	3.10	9.56	6.95	2.39	24.00	27.61
420	Harrison Bros., Philadelphia......	7.45	2.26	5.24	9.36	6.81	2.34	19.50	22.89
455	Bowker Fertilizer Co., New York	8.22	2.94	5.02	9.48	6.89	2.37	22.00	25.54
492	Moro Phillips, Camden.	9.05	1.86	6.66	9.52	6.92	2.38	23.00	26.65
518	Sharpless & Carpenter................	8.29	2.45	7.90	9.52	6.92	2.38	23.00	26.51
592	Wilson, Fitzgerald & Co..............	12.99	0.55	0.85	10.28	7.48	2.57	28.00	29.94
591	" " "	12.97	0.50	0.90	10.32	7.50	2.58	28 00	29.83
425	Mapes F. and P. G. Co., New York	11.02	1.77	3.01	10.32	7.51	2.58	27.00	28.73
521	Walton, Whann & Co., Delaware	8.83	2.99	3.37	9.68	7.04	2.42	25.00	26.06
544	E. Frank Coe, New York............	6.37	2.81	5.58	11.00	8.00	4.00	23.00	22.97
602	Walton, Whann & Co., Delaware	7.82	3.50	3.22	11.20	8.12	2.80	25.00	24.58
484	U. S. Chemical Co., Camden........	6.41	4.78	3.86	10.56	7.68	2.64	25.00	23.87
515	J. B. Sardy & Sons, New York.....	8.01	2.64	3.94	12.36	8.98	3.09	27.00	24.01
	Average..............................	....	....	....	**9.99c**	**7.26c**	**2.58c**	....	....
487	N. J. Chemical Co......................	6.26	2.74	6.09	14.32	10.40	3.58	28.00	21.50

PLAIN SUPERPHOSPHATES, From Bone Black, Etc.

Station No.	NAME AND ADDRESS OF DEALER.	Pounds per 100.			Cost per Pound.			Cost per Ton of Superphosphates.	Estimated Price per Ton.
		Phosphoric Acid soluble in Water.	Phosphoric Acid soluble in Am. Cit.	Insoluble Phosphoric Acid.	Phosphoric Acid soluble in Water.	Phosphoric Acid soluble in Am. Cit.	Insoluble Phosphoric Acid.		
438	Lister Bros., Newark.....................	17.63	0.07	0.13	7.04c	5.12c	2.56c	$25.00	$39.01
468	H. J. Baker Bros., New York.......	16.46	0.73	0.49	7.56	5.50	2.75	26.50	37.77
541	Lister Bros., Newark.....................	16.08	0.88	0.52	8.88	6.46	3.23	30.00	37.21
454	Bowker Fertilizer Co., New York	16.28	0.21	0.13	9.10	6.62	3.31	30.00	36.26
462	Geo. B. Forrester, New York.......	13.45	0.74	1.04	9.40	6.84	3.42	27.00	31.60
431	Mapes F. and P. G. Co., New York	17.57	0.56	0.77	9.59	6.98	3.49	35.00	40.16
424	" " " "	31 62	1.67	1.43	11.24	8.18	4.09	75.00	73.37
	Average..............................	....	....	....	**8.97c**	**6.52c**	**3.26c**	....	....

POTASH SALTS—HIGH GRADE SULPHATE OF POTASH.

Station No.	NAME AND ADDRESS OF DEALER.	Lbs. of Potash in 100 lbs. of Sulphate.	Cost of Potash per pound.	Cost of Sulphate of Potash per ton.
494	Moro Phillips, Camden	36.91	6.77c	$50.00
428	Mapes F. & P. Guano Co., New York	25.06	6.99	35.00
466	George B. Forrester, New York	24.10	7.77	37.50
	Average Cost of Potash per pound	....	7.17c	....

POTASH SALTS—KAINITE.

Station No.	NAME AND ADDRESS OF DEALER	Lbs. of Potash in 100 lbs of Kainite.	Cost of Potash per pound.	Cost of Kainite per ton.
411	Alex. Kerr & Bros., Philadelphia	12.80	3.90c	$10.00
418	Harrison Bros	11.91	4.20	10.00
447	Bowker Fertilizer Co., New York	11.81	4.23	10.00
510	Baugh & Sons, Philadelphia	12.84	4.28	11.00
448	Bowker Fertilizer Co., New York	12.64	4.35	11.00
473	H. J. Baker Bros., New York	12.88	4.56	11.75
417	Alex. Kerr & Bros., Philadelphia	10.89	4.59	10.00
430	Mapes F. & P. Guano Co., New York	12.31	4.87	12.00
434	Lister Bros., Newark	12.19	4.92	12.00
442	Williams, Clark & Co., New York	11.84	5.32	12.00
	Average Cost of Potash per pound	....	4.52c	....

POTASH SALTS—MURIATE OF POTASH.

Station No.	NAME AND ADDRESS OF DEALER.	Lbs. of Potash in 100 lbs. of the Muriate.	Cost of Potash per pound.	Cost of Muriate of Potash per ton.
441	Williams, Clark & Co., New York	51.55	3.68c	$38.00
464	Geo. B. Forrester, New York	50.09	3.70	37.00
474	H. J. Baker Bros., New York	48.93	3.88	38.00
429	Mapes F. & P. Guano Co., New York	51.31	3.89	40.00
435	Lister Bros., Newark	50.29	3.98	40.00
450	Bowker Fertilizer Co., New York	54.65	4.11	45.00
511	Baugh & Sons, Philadelphia	52.84	4.24	45.00
554	Robert Pond, Vineland	50.40	4.36	43.00
504	M. L. Shoemaker & Co., Philadelphia	51.01	4.42	45.00
419	Harrison Bros., Philadelphia	50.65	4.44	45.00
482	U. S. Chemical Co., Camden	49.80	4.51	45.00
	Average Cost of Potash per pound	....	4.15c	....
493	Moro Phillips, Camden	48.93	5.62	55.00

With the exception of nitrate of soda, statistics of trade in unmixed fertilizers, for the year 1883, have not yet been received.

The Oil, Paint and Drug Reporter, for January 9th, 1884, contains an interesting statistical statement, from which the following is abstracted:

EUROPEAN CONSUMPTION OF NITRATE OF SODA DURING THE FIRST SIX MONTHS OF THE FOLLOWING YEARS:

1883. BAGS.	1882. BAGS.	1881. BAGS.	1880. BAGS.
2,044,000	1,508,400	1,520,880	664,000

THE TOTAL AMOUNTS DELIVERED IN THE UNITED STATES DURING THE PAST THREE YEARS ARE AS FOLLOW:

1883. BAGS.	1882. BAGS.	1881. BAGS.
418,498	447,782	433,000

THE TOTAL DELIVERIES FOR THE WORLD DURING THE SAME PERIODS ARE:

1883. BAGS.	1882. BAGS.	1881. BAGS.
3,714,498	2,876,100	2,329,900

Taking the weight of a bag at 275 pounds, the world's supply in 1883 was, therefore, 510,734 tons; at $50 per ton, worth more than twenty-five and one-half million dollars. How much of this was used in agriculture and how much in other arts, is not known at present.

COMPLETE FERTILIZERS.

On the following pages may be found analyses of one or more brands of complete fertilizers, from nearly every manufacturer making sales in this State. As several firms, however, each advertise a number of so-called "Special Fertilizers," this list of more than *sixty samples* may not include more than one-half the brands actually exposed for sale. This does not, however, signify that so large a number of different mixtures are held in stock, as a practice prevails to a certain extent of selling the same mixture under different names.

The analyses have been tabulated in the order in which the samples were received at the laboratory. The Board of Managers of this Station regard this plan preferable to that hitherto followed of arranging the brands in the order of their relative cheapness. This change seemed necessary, as in a number of cases it has not been possible to obtain retail cash prices at manufacturers' depots, it being claimed that sales were not made to farmers in that way. In other cases it became evident that fertilizers were sold at lower prices than those quoted; Station officials were then charged by retail dealers with placing certain brands in an unfair light by publishing their prices higher than were actually charged. This was charged even when the prices published by the Station were reprinted from manufacturers' circulars, thus bringing to light the anomaly of material being cheaper, after expenses for freight and handling had been incurred, instead of dearer.

Publishing retail cash prices has therefore been discontinued, except in cases of extortionate charges.

The present low price of nitrate of soda, coupled with favorable results obtained from brands which contain it, is causing its use in complete fertilizers to become much more general. Samples in which this material is present, have been tabulated by themselves; in some respects the method followed in their analyses differing essentially from that used in other classes of fertilizers.

At present different opinions exist among chemists as to the method to be followed in the determination of total nitrogen in nitrated compounds; the so-called absolute method with copper oxide, now used in most laboratories, is admitted by many to give results which are *too high*, comparatively recent investigations showing that with certain classes of compounds the error in this direction is a very serious one. There are methods, on the other hand, which give results *too low*, making it a matter of difficulty for a chemist to select one strictly fair to both consumer and producer.

The method hitherto used by this Station has been carefully studied during the past fall, and found to be low in its results. All samples, therefore, of nitrated fertilizers made by this method have been examined a second time, both by the "absolute" process and by a modification of Ruffle's method, proposed and studied by Dr. Jenkins, of the Connecticut Station. In all cases, save one, the differences between results by these two methods have approximated one-tenth of one per cent.; in case of sample 551 the "absolute" result was a trifle more than a quarter of one per cent. higher; the difference is, however, believed to be due as much to errors in the "absolute" process as to any other cause.

The results published in this table are those given by Dr. Jenkins' method. Compared with those previously published by this Station, they approximate in some cases four-tenths of one per cent. higher, while in other cases the difference is less than two-tenths of one per cent.

If objections now existing against the "absolute" method are overcome, it will be in the future used at this Station. If not, Dr. Jenkins' method, controlled by the "absolute," will probably be used.

COMPLETE FERTILIZERS,

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station No.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station No.
416	Soluble Marine Guano	J. J. Allen & Sons, Philadelphia	Chemist of Station	416
476	Esmeralda Bird Guano	Equitable Fertilizer Co., Baltimore	" " "	476
497	Swift Sure Superphosphate	M. L. Shoemaker & Co., Philadelpbia	" " "	497
514	Sardy's Phospho. Peruvian Guano	J. B. Sardy & Son, New York	Theo. Beekman, Middlebush	514
526	Potato Fertilizer	Lister Bros., Newark	T. V. Duboise, Freehold	526
549	"A" Brand	Mapes F. and P. Guano Co., New York	Chemist of Station	549
551	Corn Fertilizer	" " " "	" " "	551
557	"A" Brand	" " " "	Assistant Chemist of Station	557
559	Complete Fertilizer	Rend Rock Powder Co., New York	A. Ryerson, Mountain View	559
569	Grass Fertilizer	H. J. Baker & Bro., New York	Chemist of Station	569
581	The Bay State Fertilizer	Clark's Cove Guano Co , Massachusetts	Assistant Chemist of Station	581
598	Soluble Pacific Guano	Glidden & Curtiss, Boston	" " " "	598

COMPLETE FERTILIZERS,

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station No.	BRAND.	Nitrogen.				Phosphoric Acid.			Potash.		Estimated Value per Ton.	Station No.
		From Nitrates.	From Ammonia.	From Organic Matter.	Total.	Soluble in Water.	Soluble in Am. Cit.	Insoluble.	As Sulphate.	As Muriate.		
416	Allen's Marine Guano	0.23	1.65	1.87	3.75	4.08	1.82	5.27	....	1.91	$37.82	416
476	Esmeralda Bird Guano	1.05	1.74	1.25	4.04	....	3.64	11.75	....	3.66	42.08	476
497	Shoemaker's Swift Sure Superphosphate	0.75	....	1.84	2.59	8.17	3.32	2.84	....	3.62	40.63	497
514	Sardy's Phospho. Peruvian Guano	1 15	....	.88	2.03	5.88	2.92	3.16	....	0.98	30.88	514
526	Lister Bros.' Potato Fertilizer.	0.85	0.55	2.00	3.40	7.82	1.88	1.02	2.20	.28	48.51	526
549	Mapes "A" Brand	0.98	0.45	1.01	2.44	4.90	4.50	5.66	....	2.09	37.47	549
551	" Corn Manure	1.25	0.87	1.42	3.54	6 14	2	2.14	....	6.16	48.00	551
557	" "A" Brand	0.43	0.44	1.74	2.61	4.	4.55	5.89	....	2.85	37.17	557
559	Rend Rock Company's Complete Fertilizer	3.84	....	....	3.84	5.76	1.91	3.18	....	6.25	40.15	559
569	H. J. Baker's Grass Fertilizer	1.04	3.20	0.49	4.73	4.76	0.73	0.92	....	7.27	41.97	569
581	Clark's Cove Company's Bay State	1.34	1.13	0.54	3.01	7.77	3.08	1.86	....	1.96	39.64	581
598	Soluble Pacific Guano	0.76	0.57	1.22	2.55	5.73	2.19	4.86	....	3.13	35.61	598

COMPLETE FERTILIZERS,

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station No.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station No.
456	Excelsior	Coe & Richmond, New York	Chemist of Station	456
477	Bone Fertilizer	I. S. Yarnell, Media, Pa.	" " "	477
480	National Superphosphate	U. S. Chemical Co., Camden	" " "	480
481	Tobacco Fertilizer	" " " "	" " "	481
483	Potato Fertilizer	" " " "	" " "	483
485	Button Bone Fertilizer	N. J. Chemical Co., Camden	" " "	485
486	Acidulated Fish Guano	" " " "	" " "	486
488	Ammoniated Superphosphate	" " " "	" " "	488
491	Phuine	Moro Phillips, Camden	" " "	491
496	Supherphosphate of Lime	" "	" " "	496
509	Tobacco Fertilizer	Baugh & Sons, Philadelphia	" " "	509
520	Alkalized Guano	Hurtado & Co., New York	Amos Ebert, Kirkwood, N. J.	520
522	Plow Brand	Walton, Whann & Co., Wilmington, Delaware	J. B. Thompson, Freehold, N. J.	522
525	Potato Fertilizer (Stockbridge)	Bowker Fertilizer Co., New York	T. V. Duboise, Freehold, N. J.	525
527	" "	Russel Coe, Linden, N. J.	" " " "	527
528	Meat, Blood and Bone Fertilizer	M. F. Jones, Matawan, N. J.	" " " "	528
529	Dissolved Bone	Bowker Fertilizer Co., New York	Peter Q. Hoagland, Frankfort	529

COMPLETE FERTILIZERS,

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station No.	BRAND.	Nitrogen.			Phosphoric Acid.			Potash.		Estimated Value per Ton.	Station No.
		From Ammonia.	From Organic Matter.	Total.	Soluble in Water.	Soluble in Am. Cit.	Insoluble.	As Sulphate.	As Muriate.		
456	Coe & Richmond's Excelsior	1.11	2.34	3.45	3.31	0.91	1.36	2.30	1.00	$41.95	456
477	Yarnell's Bone Fertilizer	0.94	1.97	2.91	4.57	1.96	5.19	....	3.66	36.48	477
480	U. S. Chemical Co , National Superphosphate	....	2.19	2.19	6.25	3.40	2.78	....	2.01	34.31	480
481	" " " Tobacco Fertilizer	....	1.50	1.50	5.09	3.29	3.65	....	3 20	30.76	481
483	" " " Potato Fertilizer	....	1.43	1.43	5.17	3.53	3.40	....	3.56	30.72	483
485	N. J. Chemical Co.'s Button Bone Fertilizer	0.43	0.59	1.02	1.60	2.66	3.80	....	3.07	18 90	485
486	" " " Acidulated Fish Guano	0.37	1.41	1.	4.31	1.61	5.19	....	1.09	28.73	486
488	" " " Ammoniated Superphosphate, W. & C.	....	0.98	0.98	4.50	2.25	7.11	....	1.91	28.16	488
491	Moro Phillips' Phuine	....	1.52	1.52	3.64	1.94	3.64	....	2.80	24.85	491
496	" " Superphosphate of Lime	....	1.75	1.75	7.53	1.90	3.69	....	2.42	34.15	496
509	Baugh's Tobacco Fertilizer	....	3.68	3.68	3.20	2.40	2.96	....	2.71	33.48	509
520	Hurtado's Alkalized Guano	6.93	....	6.93	0.69	5.90	7.16	2.92	1.93	61.32	520
522	Walton, Whann & Co., Plow Brand	....	1.87	1.87	5.32	1.92	5.12	....	2.31	32.57	522
525	Stockbridge's Potato Fertilizer	0.36	2.38	2.74	5.90	0.66	1.81	4.60	....	35.47	525
527	Russel Coe's Potato Fertilizer	0.15	3.15	3.30	5.13	1.46	1.65	1.80	4.24	37.00	527
528	Jones' Meat, Blood and Bone Fertilizer	....	0.97	0 97	1.39	0.72	1.07	....	2.33	13.03	528
529	Bowker's Dissolved Bone	....	0.71	0.71	2.24	5.36	2.51	....	0.86	20.52	529

COMPLETE FERTILIZERS,

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station No.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station No.
530	Hill and Drill Fertilizer	Bowker Fertilizer Co., New York	P. Q. Hoagland, Frankfort, N. J	530
531	Brighton Phosphate	" " " "	" "	531
532	Wagner's Mineral Fertilizer	Jeptha A. Wagner & Co., New York	" "	532
533	Standard Superphosphate	Lister Bros., Newark, N. J	Geo. La Monte, Bound Brook	533
534	Potato Fertilizer	" " "	" "	534
536	Ammoniated Dissolved Bone	" " "	James Polhemus, "	536
537	Potato Fertilizer	Geo. B. Forrester, New York	" "	537
540	Plow Brand	Walton, Whann & Co., Wilmington, Del	Wm. H. Grant, Red Bank	540
542	Cabbage Fertilizer	Geo. B. Forrester, New York	A. W. Duryea, New Durham	542
543	Potato Fertilizer	" "	" "	543
546	Alkaline Bone	E. Frank Coe, New York	David C. Voorhees, Blawenburg	546
547	Ralston's Potato Fertilizer	" "	" "	547
548	Bone Superphosphate	" "	" "	548
552	Ammoniated Phosphate	Geo. W. Baker, "	Chemist of Station	552
555	Superphosphate	Farmers' Fertilizer Co., New York	S. C. Dayton, Basking Ridge	555
558	Excelsior	Coe & Richmond, Mantua Point	Hon. T. M. Ferrell, Glassboro	558
562	Bone Phosphate	J. I. Smith, Trenton, N. J	Wm. Meley, Trenton	562

COMPLETE FERTILIZERS,

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station No.	BRAND.	Nitrogen.			Phosphoric Acid.			Potash.		Estimated Value per Ton.	Station No.
		From Ammonia.	From Organic Matter.	Total.	Soluble in Water.	Soluble in Am. Cit.	Insoluble.	As Sulphate.	As Muriate.		
530	Bowker's Hill and Drill	0.22	1.46	1.68	4.30	3.26	2.06	....	1.88	$26.18	530
531	" Brighton Phosphate	....	0.88	0.88	0.92	5.15	5.63	0.58	1.93	23.52	531
532	Wagner's Mineral Fertilizer	....	0.12	0.12	....	0.93	0.46	....	1.75	4.08	532
533	Lister Bros.' Standard	0.64	1.57	2.21	9.28	2.12	1.57	....	2.11	38.03	533
534	" Potato Fertilizer	0.76	2.53	3.29	7.41	0.77	0.88	....	7.57	40.62	534
536	" Ammoniated Dissolved Bone	0.46	1.19	1.65	9.47	1.02	0.99	....	1.72	32.97	536
537	Forrester's Potato Fertilizer	4.15	....	4.15	4.68	1.01	0.54	2.51	7.05	43.65	537
540	Walton, Whann & Co.'s Plow Brand	....	1.77	1.77	5.86	1.93	4.47	....	2.01	31.19	540
542	Forrester's Cabbage Fertilizer	4.90	....	4.90	5.45	1.10	0.49	....	8.01	46.61	542
543	" Potato "	4.19	....	4.19	4.90	1.00	0.67	3.82	6.54	45.18	543
546	E. Frank Coe's Alkaline Bone	....	0.91	0.91	6.40	1.44	5.20	....	1.88	28.41	546
547	Ralston's Potato Fertilizer	0.59	1.60	2.19	7.09	1.05	3.44	3.09	0.71	36.77	547
548	E. Frank Coe's Bone Superphosphate	0.59	1.70	2.29	7.05	1.60	3.28	1.09	0.53	34.88	548
552	G. W. Baker's Ammoniated Superphosphate	....	0.74	0.74	0.62	1.64	0.63	....	1.06	9.04	552
555	Farmers' Fertilizer Co.'s Phosphate	0.13	1.19	1.32	6.02	1.15	2.67	....	1.25	25.49	555
558	Coe & Richmond's Excelsior	0.66	2.83	3.49	9.13	0.89	0.63	....	5.26	42.89	558
562	J. I. Smith's Bone Phosphate	....	1.58	1.58	4.43	4.93	2.14	....	3.50	30.81	562

COMPLETE FERTILIZERS,

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station No.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station No.
563	Cabbage Fertilizer	Williams, Clark & Co., New York	Chemist of Station	563
564	Americus Bone Superphosphate	" " " "	" " "	564
566	Ammoniated Bone Superphosphate	Russel Coe, Linden, N. J.	" " "	566
567	Davidge's Favorite for Cereals	" " " "	" " "	567
570	Turnip Fertilizer	H. J. Baker & Bro., New York	" " "	570
571	A. A. Ammoniated Superphosphate	" " " "	" " "	571
572	Potato Fertilizer	" " " "	" " "	572
574	Allentown Bone Mill	Allentown, Pa., Manufacturing Co	Wm. H. Wyckoff, Frankfort	574
575	Standard	A. Mitchell, Jr., Newark	Assistant Chemist of Station	575
577	Soluble Pacific Guano	Pacific Guano Co., Boston	" " " "	577
580	Unicorn	Clark's Cove Guano Co., New Bedford, Mass	" " " "	580
582	Potato Fertilizer	" " " " " " "	" " " "	582
595	Grangers'	Grangers & Co., Philadelphia	S. L. Borrough, Merchantville	595
596	Cooke's Blood Guano	Manhattan Chemical Co., New York	H. J. Garrison, Bound Brook	596
600	Complete Bone Phosphate	Allentown, Pa., Manufacturing Co	Hiram Holcombe, Montgomery	600
603	Home	(?)	Wm. R. Hancock, Columbus	603

COMPLETE FERTILIZERS,

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station No.	BRAND.	Nitrogen.			Phosphoric Acid.			Potash.		Estimated Value per Ton.	Station No.
		From Ammonia.	From Organic Matter.	Total.	Soluble in Water.	Soluble in Am. Cit.	Insoluble.	As Sulphate.	As Muriate.		
563	Williams, Clark & Co., Cabbage Fertilizer	....	2.88	2.88	5.08	1.55	1.95	....	5.51	$33.93	563
564	" " " Bone Phosphate	....	1.62	1.62	4.88	1.70	3.56	....	1.48	26.44	564
566	Russel Coe's Ammoniated Superphosphate	....	1.97	1.97	4.76	1.49	2.71	....	1.89	26.34	566
567	Davidge's Favorite for Cereals	....	1.42	1.42	6.18	1.46	3.69	....	1.22	27.83	567
570	H. J. Baker & Bro., Turnip Fertilizer	5.20	0.46	5.66	5.31	0.27	0.22	1.69	7.21	50.03	570
571	" " A. A. Ammoniated	1.93	0.55	2.48	10.24	0.78	0.40	....	4.44	40.60	571
572	" " Potato Fertilizer	2.93	0.48	3.41	5.94	0.52	0.26	....	10.46	40.55	572
574	Allentown Bone Mill	....	0.96	0.96	5.41	4.23	1.82	....	1.73	26.74	574
575	A. Mitchell's, Jr., Standard	....	0.80	0.80	6.97	1.44	3.09	....	0.93	26.29	575
577	Soluble Pacific Guano	....	1.46	1.46	6.08	2.11	6.23	....	0.72	31.46	577
580	Clark's Cove Co.'s Unicorn	....	1.95	1.95	7.19	1.26	2.49	....	1.66	31.21	580
582	" " " Potato Fertilizer	2.33	0.87	3.20	6.37	0.77	1.56	....	9.45	41.22	582
595	Grangers' Fertilizer	1.17	0.79	1.96	0.73	4.24	1.28	....	0.58	20.09	595
596	Cooke's Blood Guano	0.57	0.62	1.19	5.48	1.78	1.26	....	1.09	23.05	596
600	Allentown Complete Bone Phosphate	....	1.36	1.36	4.82	3.83	2.13	....	1.69	25.09	600
608	Home Fertilizer	0.65	0.71	1.36	4.33	1.03	2.10	....	2.25	22.26	608

GROUND BONE,

Furnishing Nitrogen and Insoluble Phosphoric Acid.

Station No.	BRAND.	MANUFACTURER	SAMPLED BY.	Station No.
459	Geo. B. Forrester's Pure Ground Bone	Geo. B. Forrester, New York	Chemist of Station	459
460	" Fine "	" "	" " "	460
469	Pure Ground Bone	H. J. Baker & Bro., New York	" " "	469
475	Button Bone	L. Moritz, Philadelphia	" " "	475
498	Swift Sure Bone Meal	M. L. Shoemaker & Co., Philadelphia	" " "	498
502	Western "	" " "	" " "	502
518	Pure "	Baugh & Sons, Philadelphia	" " "	518
545	Ground Bone	E. Frank Coe, New York	David C. Voorhees, Blawenburg	545
550	Fine "	Mapes F. and P. Guano Co., New York	Chemist of Station	550
556	Crescent "	Lister Bros, Newark	Assistant Chemist of Station	556
561	Ground "	John I. Smith, Trenton	Wm. J. Meley, Trenton	561
578	Cooper's Bone Meal	Peter Cooper's Glue Works, New York	Henry H. Tiger, Mendham	578
579	Ground Bone	Preston's Fertilizer Co., Green Point, L. I.	Assistant Chemist of Station	579
585	Pure Ground Bone	Terry Clancey, New Brunswick	" " " "	585
590	" Fine Ground Bone	Depue & Co., Belvidere	Caleb Wyckoff, Belvidere	590
601	Ground Bone	John Smith	Frank L. Janeway, New Brunswick	601

GROUND BONE,

Furnishing Nitrogen and Insoluble Phosphoric Acid.

Station No.	MANUFACTURERS.	Mechanical Analysis.					Chemical Analysis.			Estimated Value per Ton.	Station No.
		Finer than 1-50 inch.	Finer than 1-25 inch.	Finer than 1-12 inch.	Finer than 1-6 inch.	Coarser than 1-6 inch.	Nitrogen.	Phosphoric Acid.	Potash.		
459	Geo. B. Forrester	21.9	42.	30.7	5.4	....	3.15	20.39	....	$31.50	459
460	" "	62.7	27.2	7.9	2.2	....	1.52	23.81	....	31.72	460
469	H. J. Baker & Bro.	13.3	18.7	25.	42.	1.	3.80	23.37	....	34.14	469
475	L. Moritz	15.1	15.	28.7	29.5	11.7	3.77	25.70	....	36.04	475
498	M. L. Shoemaker & Co.	55.3	31.1	13.6	....	....	5.91	22.11	....	44.41	498
502	" "	58.	42.	....	....	....	3.58	22.63	....	37.78	502
513	Baugh & Sons	37.8	57.	5.2	....	....	3.45	22.69	....	36.58	513
545	E. Frank Coe	46.2	25.4	15.2	8.6	4.7	1.96	11.07	2.08	19.95	545
550	Mapes F. and P. Guano Co.	24.8	23.	20.	32.2	....	2.23	28.03	....	35.70	550
556	Lister Bros.	24.4	16.8	16.7	19.5	22.6	2.29	14.08	....	20.51	556
561	John I. Smith	11.6	14.5	24.5	49.4	....	4.09	21.72	....	32.91	561
573	Peter Cooper Glue Co.	40.8	23.	15.6	26.	....	1.39	32.86	....	39.86	573
579	Preston Fertilizer Co.	23.5	18.2	19.5	18.8	20.	3.34	15.65	....	25.15	579
585	Terry Clancey	17.5	19.	20.	24.	19.5	3.43	20.26	....	29.59	585
590	Depue & Co	21.7	39.5	27.5	11.3	....	2.29	12.53	....	20.22	590
601	John Smith	32.	31.	25.	12.	....	4.51	20.28	....	35.64	601

DISSOLVED BONES & NITROGENOUS SUPERPHOSPHATES,

Furnishing Nitrogen and Phosphoric Acid.

Station No.	BRAND.	MANUFACTURER.	SAMPLED BY.
421	Dissolved Bone	Harrison Bros., Philadelphia	Chas. Collins, Fellowship, N. J.
500	Swift Sure Dissolved Bone	M. L. Shoemaker, "	Chemist of Station.
508	$25 Phosphate	Baugh & Sons, "	" "
512	Pure Dissolved Bone	" "	" "
560	Superphosphate	Elizabethport Glue Co	J. S. Grover, Red Bank.
565	Amm. Dissolved Bone	Williams, Clark & Co., N. Y.	Chemist of Station.
576	Complete Bone Manure	Allentown, Pa., Fertilizer Co	Assistant Chemist of Station.
578	Amm. Bone Superphosphate	Preston's Fertilizer Co	" " "
589	XXX Bone	Depue & Co., Belvidere	Caleb Wyckoff, Belvidere.
597	Cooke's Diss'd Ground Bone	Manhattan Chemical Co	W. S. Negus, Bound Brook.

Analyses and Valuations.

Station No.	MANUFACTURER.	Organic Nitrogen.	Phosphoric Acid.			Potash.	Estimated Value per Ton.
			Soluble in Water.	Soluble in Am. Cit.	Insoluble.		
421	Harrison Bros	2.99	4.40	8.67	1.48	....	$39.02
500	Shoemaker & Co.	2.38	10.33	2.60	3.71	....	42.28
508	Baugh & Sons	1.41	3.89	1.48	6.92	....	24.54
512	" "	2.28	1.88	10.56	3.69	....	35.96
560	Elizabethport Glue Co.	0.81	3.33	4.89	3 92	....	23.57
565	Williams, Clark & Co.	1.59	6.05	2.40	3.71	....	28.91
576	Allentown Manufacturing Co.	1.47	1.87	6.48	2.59	....	24.27
578	Preston & Sons	2.21	6.40	1.28	3.76	....	30.78
589	Depue & Co.	1.92	2.27	4.78	2.61	....	24.52
597	Manhattan Chemical Co.	....	8.65	2.46	2.92	0.51	26.90

MISCELLANEOUS FERTILIZERS.

POUDRETTES.

Station No.	BRAND.	MANUFACTURER.	SAMPLED BY.
586	Poudrette	Terry Clancey, New Brunswick	Assistant Chemist of Station.
587	"	Ebeling Bros., Newark	" " "

Analyses and Valuations.

Station No.	BRAND.	MANUFACTURER.	Percentage.			Estimated Value per ton.
			Nitrogen.	Phosphoric Acid.	Potash.	
586	Poudrette	Terry Clancey	0.88	2.84	.41	$7.81
587	"	Ebeling Bros	0.61	2.10	.19	5.49

Poudrettes are made by absorbing night soil in some porous substance. The mechanical condition of both of the above samples was good. The amount of plant-food, however, which they contain, is too small to admit of their being profitably used at any considerable distance from the place where they are prepared, unless transportation facilities are unusually favorable.

MISCELLANEOUS.

Station No.	BRAND.	MANUFACTURER.	SAMPLED BY.
413	Apple Pomace Ash	J. W. B. Wharf, Philadelphia	S. R. Lippincott, Hartford, N. J.
412	Tankage	Hon. John Taylor, Trenton	Chemist of Station.
539	Rotten Bone	G. W. Baker, Brooklyn	J. Belcher, New Brunswick.
538	Corena Settlings	" "	" "

Analyses and Valuations.

Station No.	BRAND.	MANUFACTURER.	Percentage.			Estimated Value per ton.
			Nitrogen.	Phosphoric Acid.	Potash.	
418	Ash from Apple Pomace.	J. W. B. Wharf, Philadelphia.....	....	6.80	11.88	$17.79
412	Tankage..........................	Hon. John Taylor, Trenton.......	8.08	22.84	....	28.96
589	Rotten Bone......................	G. W. Baker, Brooklyn..............	2.97	2.84	....	17.07
588	Corena Settlings...............	" "	0.14	0.79	0.62	2.12

LIME.

No. 458, Marble Lime. Sampled by M. C. Swift, Hammonton; contains 60 per cent. of Lime and 14.40 per cent. of Magnesia; cost 15 cents per bushel of 80 pounds or $3.75 per ton.

No. 593, White Lime. Sampled by Joseph A. Fritts, Annandale; contains 46.27 per cent. Lime and 25.67 per cent. Magnesia; cost 10 cents per bushel of 80 pounds or $2.50 per ton.

FLOATS.

No. 516, Atomized Phosphate. Sold by J. B. Sardy & Sons, New York. Sampled by Mr. Theo. Beekman, Blackwell's Mills; contains 37.02 per cent. total Phosphoric Acid; costs $24 per ton.

This is probably a sample of what is known in the Southern States as Floats, or finely-ground South Carolina rock phosphate.

WOOD ASHES.

No. 517, Ash from tanners' spent hemlock bark. Sold by Hoyt Brothers, Blossburg, Penn. Sampled by James Schureman, New Brunswick; contains Phosphoric Acid, 2.05 per cent.; Potash, 3.67 per cent., and Lime, 54.52 per cent.; cost $5.50 per ton or 18 cents per bushel, at New Brunswick.

For comparison we insert analyses of two samples of unleached ashes, and one of Canada leached ashes. The last three are taken from the reports of the Connecticut Experiment Station.

ASHES.	Phosphoric Acid.	Potash.	Lime.
Spent Hemlock Bark, unleached	2.05	3.67	54.52
Oak Wood, unleached	2.42	9.37	29.65
Hickory Wood, unleached	1.63	4.56	36.29
Canada Ashes, leached	2.02	1.29	33.59

LEATHER WASTE.

No. 489. Sampled by chemist of the Station, at the works of Moro Phillips, Camden; contains 7.56 per cent. Organic Nitrogen.

This material is not offered for sale in its raw condition by the above firm. It is first decomposed with sulphuric acid, and then mixed with stock containing phosphoric acid and potash.

Leather decomposes very slowly in the ground, and is consequently of little value as a fertilizer, when rapid action is wanted. In some States its sale in commercial fertilizers is legally restricted.

Ten years ago a quantity of this waste was used experimentally on the College Farm; for a long time it remained without noticeable effect. At present, however, decomposition is slowly progressing, the crops on the spot where it was used appearing greener and more thrifty than the surrounding field.

When leather scrap can be obtained for the expense of hauling, it may pay to compost it at a season of the year when farm work is slack, but its use in mixed fertilizers should be prohibited by law.

WOOL WASTE.

No. 415. From the Bound Brook Woolen Mills. Sampled by Mr. L. D. Cook, Bound Brook; contains 6.95 per cent. of Organic Nitrogen.

Conflicting reports as to the value of this waste are recorded in countries where experiments with it have been tried.

In England, where years ago $10 per ton seems to have been its usual price, it is regarded favorably by some and unfavorably by others. Dr. Voelckert offers an explanation of its varying results, by stating that it at times contains twenty per cent. and more of oil, which prevents water from coming in contact with the fiber, and consequently retards decomposition. On light open soils it rots much more quickly than on heavy clay lands.

Extensive experiments are now in progress on several farms in this State. Mr. Voorhees, of Branchville, composted twenty loads of the waste with thirty-three loads of yard manure. This quantity was spread on nine acres of wheat land, which had been previously fertilized with 200 pounds of bone black superphosphate per acre. As another portion of the same field was heavily dressed with yard manure only, the comparative value of the waste on this farm will be known next season.

On a farm in the neighborhood of New Brunswick about ten acres of light soil were also heavily dressed with this waste. In this case shell lime was mixed with the wool and then slacked; wheat was drilled on this field.

On the College Farm rather heavy, low-lying land was also dressed with this material, previously well mixed with slacked lime.

The yield of wheat from this plot will be compared with that from another portion of the same field, which will be top-dressed this spring with nitrate of soda.

Another experiment has been started on wheat drilled on this farm. In this case the waste was thoroughly soaked in a strong solution of caustic potash. The evolution of ammonia indicated that the fiber was attacked. This waste was then mixed with dry earth and broadcasted on a measured area. Compared with it are plots on one of which untreated waste, mixed with soil, was used, and on another an amount of caustic potash equal to that used on the waste. This potash was dissolved in water, then thoroughly mixed with soil and broadcasted.

The results of all the above experiments will be published next fall.

II.

AGRICULTURAL RELATIONS.

Thus far in this report fertilizers have been considered only as articles of commerce, like lumber, iron, leather or any similar material. These all have market values, independent of the use which any individual makes of them.

The *agricultural* value of a fertilizer is measured not by its market price, but by the improvement it causes both in quantity and quality of a crop on which it has been applied.

As skill and experience is necessary before a builder can select and profitably use the lumber necessary for his work, so equal skill and knowledge, at least, is necessary before farmers can select and use the fertilizers needed by their soils.

If a farmer buys and uses nitrogen, when his crop demands the relatively cheaper potash or phosphoric acid, he suffers for his lack of knowledge, as much as a builder who uses black walnut, where pine would be more suitable.

The letters received at this Station indicate clearly that New Jersey farmers are rapidly awakening to the necessity of devoting more thought to this part of their business. The general drift of these letters is:

First. How can fertilizers be obtained at more reasonable prices?

Second. How can greater economy be practiced in their use?

To many it has become evident that a complete fertilizer is a mixture simply, and that one dealer may have facilities which allow him to undersell on phosphoric acid, while a second and third may control the market on nitrogen and potash.

Some farmers now believe that, by purchasing these materials where they can be had at their lowest prices, and mixing them in January and February, when farm work is slack, not only can they obtain cheaper fertilizers, but can also profitably employ their own laborers in making the mixtures. Inquiries are therefore common as to the proportions to be followed in making up complete manures.

As field experiments on subsequent pages show, no one can tell, without previous trial, the *elements* even, still less the exact *amounts* of those elements necessary to raise on a given field the largest crop for the least money. In replying, therefore, to letters, the general custom of the Station has been to give a receipt which will yield a mixture similar in composition to those offered for sale by reputable manufacturers.

As a fertilizer for general use either of the following may be used:

120	lbs. of	Sulphate of Ammonia.
170	"	Dried Blood.
1,590	"	Bone Black Superphosphate.
70	"	Muriate of Potash.
1,950	lbs.	

120	lbs. of	Nitrate of Soda.
90	"	Sulphate of Ammonia.
145	"	Dried Blood.
1,545	"	Bone Black Superphosphate.
120	"	Muriate of Potash.
2,020	lbs.	

Fertilizers similar in composition to the above mixture, are regarded favorably in many sections of this State, particularly on wheat.

For corn or potatoes, the amount of nitrogen can be decreased and the potash proportionally increased, with profit.

A question of far greater importance to the farmer is that of greater economy in the use of fertilizers.

This involves first and foremost a knowledge of the particular effects of different fertilizing elements, as well as a knowledge of the chemical and mechanical condition of the particular field on which a crop is grown. It involves further a knowledge of the proper time for applying fertilizers, as well as definite information as to the limits in quantity which can be used with profit.

The peculiar power of some plants, noticeably clover and corn, to obtain nitrogen from soils, on which cereals cannot gather their supply, illustrates the fact that the habits of plants themselves must also be studied in this connection.

Regarding the peculiar effects of fertilizing elements, certain general principles are already known; nitrogenous manures especially favor the growth of leaves, potash the growth of stems, and phosphoric acid the development of seeds. Nitrogenous manures retard the ripening of grain, while phosphoric acid hastens it. Potash favors the increase and quality of products rich in sugar and starch. The chemical condition of a field, the limits as to quantity of fertilizers to be used with profit, the time of year for using them, and to a certain extent the habits of plants, can be studied best by field experiments.

Those conducted by farmers in this State during the past three years have been planned by the Station:

First. To familiarize farmers with the general appearance of materials furnishing nitrogen, phosphoric acid and potash.

Second. To show the effect of these elements, when used alone and in combination on different crops grown on widely differing soils.

A body of trained experimenters is thus being secured, whose own interest will soon lead them to demand more complicated trials.

Results obtained this year, and considered in detail on the following pages, are in some cases of considerable interest.

The effect of potash on corn is strikingly illustrated by Mr. Voorhees' work; wherever it was used financial profit resulted, and wherever it was omitted there was financial loss.

On the College Farm, potash, as in many previous years, regulated the increase of crop, but resulted in financial loss; the large amount of barn-yard manure used in past years rendering the application of fertilizers of but little avail. The effect of potash in influencing the development of sugar is seen in the sorghum experiment, while nitrate of soda, used as a top-dressing for wheat, shows that the question of time of applying fertilizers is worthy of much attention.

Mr. Arnold's experiments on sweet-potatoes indicate that both quantity and quality were noticeably influenced by potash, agreeing with previous experiments made on this farm with the same crop.

The experiments of Mr. Stephen Dayton and of Dr. C. W. Larison, in the use of fertilizers on their soils, are of special interest. They are both on soils derived from disintegrated trap-rock, and the effects of fertilizers are the same upon both farms, while they are singularly different from those upon the red shale soils of Mr. Thompson and Mr. Voorhees, as well as from the more sandy soil of Mr. Arnold.

Experiments were begun this year upon the gneissic soil of Schooley's mountain, by Mr. N. S. Sergent, but the early growth of the corn was greatly retarded by cut-worms, and, when it did grow, the uncommonly early frost came and destroyed the crop before it was ripe enough to harden.

Experiments were begun upon the limestone and also upon the slate-soils of the Musconetcong Valley, by Mr. W. D. Vliet, of Hackettstown, but the crop was late, and frost killed it so early in its growth that no proper conclusions can be drawn from its product as influenced by fertilizers.

A series of experiments on the growth of wheat, treated with different fertilizers, was begun in the fall of 1882, but the unexampled rain-fall which came soon after the seed was sown, so washed and mixed the soils that no trustworthy results could be given.

The general results of the experiments, upon the different classes of soils in the State, are such as to show that it is a line in which experiments can be conducted with a reasonable expectation of benefiting farmers and bringing out the best qualities of our soils. We need the coöperation of intelligent and pains-taking farmers to carry out the best field experiments in different sections of the State, and invite correspondence having that object in view.

FIELD EXPERIMENTS WITH FERTILIZERS ON CORN.

By Mr. John Voorhees, South Branch, Somerset County, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.			
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Ears Good.	Pounds of Ears Poor.	Bushels of Shelled Corn.	Pounds of Stalks.
1	Nothing			2,300	240	32.0	2,060
2	Nitrate of Soda	150 lbs.	$4.50	2,430	390	33.7	2,320
3	Superphosphate	350 "	5.25	2,020	310	28.0	1,970
4	Muriate of Potash	150 "	3.25	4,430	50	61.5	3,080
5	Nitrate of Soda Superphosphate	150 350 "	9.75	1,770	405	23.2	1,900
6	Nothing			1,370	300	19.0	1,700
7	Nitrate of Soda Muriate of Potash	150 150 "	7.75	3,960	60	55.0	2,920
8	Superphosphate Muriate of Potash	350 150 "	8.50	4,980	50	69.2	3,590
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 " 150	13.00	4,790	40	66.5	3,420
10	Plaster	400 "	1.50	2,370	285	33.0	2,110
11	Fine Barn-yard Manure	20 2-horse loads.	30.00	5,060	50	70.3	3,730

This is the first of a series of field experiments with fertilizers to be carried out upon this farm. The soil upon which this trial was conducted is a clay loam, and represents about two-thirds of the farm, the remainder being a red shale. The treatment for the past twenty years has been to dress lightly once in five years with barn-yard manure, usually applied upon wheat.

The rotation of crops has been corn, oats, wheat and grass for two years. Since 1873 the farm has received two coats of lime.

This farm is particularly adapted to this kind of experimental work, as artificial manures have never been used.

The average production of shelled corn per acre has been about forty bushels.

The past season was not considered favorable, the unmanured plots yielding at the rate of thirty-two bushels per acre. Though the results for one year may admit of certain inferences as to the effect of different fertilizers, calculation of profits should be determined by averaging the results of several years.

Plots Nos. 2, 3, 5 and 10 did not respond to the use of fertilizers by increasing the yield of either corn or stalks, showing that nitrate of soda and superphosphate, neither alone nor in combination with each other, are profitable; plaster also had no effect.

On the other hand, plots Nos. 4, 7, 8, 9 and 11, where potash is used, both alone and in combination with phosphoric acid and nitrogen, show an enormous increase in yield. Regarding 72 pounds of ears equivalent to one bushel of shelled corn, 55 cents as the price per bushel, and $6 per ton the value of stalks: plot No. 4 shows that an outlay of $3.25 per acre increases the yield of corn 29.5 bushels, and stalks 1,000 pounds, a net profit of $16 per acre; plot No. 8, with an outlay of $8.50, yields a net profit of $16.50 per acre; plots Nos. 7 and 9 yield a profit of $7.50 and $10, respectively; plot No. 11, with an outlay of $30 for barn-yard manure, though increasing the yield of both corn and stalks, shows a loss of $4 per acre.

The application of potash yields large profits in every case; phosphoric acid is profitable in one case only, and that when in combination with potash; nitrogen does not increase the yield in any case.

The quality of the corn was also favorably influenced by the use of potash, a fact indicated by the decrease in yield of soft corn, which, in every case, vary considerable. These results confirm those obtained last year by Rev. Henry P. Thompson, of Readington, whose farm is situated about three miles to the northeast of South Branch. Both experiments show that large profits were derived from the use of potash and phosphoric acid, though the effect of potash alone is more striking in the case of Mr. Voorhees.

The soil in this section being mostly red shale loam, it is more than probable that these experiments by Mr. Thompson and Mr. Voorhees may serve as guides in the use of fertilizers to all the farmers upon similar soils.

FIELD EXPERIMENTS WITH FERTILIZERS ON CORN.

By Theodore West, College Farm, New Brunswick, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.		
	Kind.	Weight per Acre.	Cost per Acre.	Pounds per Acre.	Bushels of Shelled Corn.	Pounds of Stalks.
1	Nothing........................	....	....	4,600	63.9	4,500
2	Nitrate of Soda.............	150 lbs.	$4.50	4,500	62.5	4,000
3	Superphosphate	350 "	5.25	4,500	62.5	4,200
4	Muriate of Potash.........	150 "	3.25	4,700	65.3	4,600
5	Nitrate of Soda............. Superphosphate	150 350 "	9.75	4,900	69.4	4,050
6	Nothing........................	....	....	4,650	64.5	3,700
7	Nitrate of Soda............. Muriate of Potash.........	150 150 "	7.75	5,300	73.6	4,300
8	Superphosphate .... Muriate of Potash.........	350 150 "	8.50	5,115	71.0	4,600
9	Nitrate of Soda............. Superphosphate............ Muriate of Potash.........	150 350 " 150	13.00	5,300	73.6	4,600
10	Plaster......	400 "	1.50	4,600	63.9	3,800
11	Fine Barnyard Manure...	20 2-horse loads.	30.00	5,100	70.8	4,400

The field upon which this experiment was conducted had been lying in grass for three years. During this time no fertilizers were applied, but during several years previous it had received large quantities of barn-yard manure.

Potash has for years been recognized as the element which causes an increase in the yield of corn on this farm. The above results offer no exception to this rule.

In this respect, Mr. Voorhees' work agrees with that on the College Farm.

These two experiments, however, teach widely different lessons.

Mr. Voorhees learns that certain fertilizing elements will largely increase his profits.

Mr. West learns that on this field his profit will be diminished nearly in proportion as the prices of the fertilizers used increase.

This is a valuable lesson, indicating that plant-food alone cannot indefinitely increase crops; further, that the best fertilizers, even in a favorable season, may fail to yield profit, simply because the material added already existed in sufficient quantities in the soil.

FIELD EXPERIMENTS WITH FERTILIZERS ON POTATOES.

By Rev. Henry P. Thompson, Readington, Hunterdon County, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.		Gain or Loss per Acre in Bushels.
	Kind.	Weight per Acre.	Cost per Acre.	Pounds.	Bushels.	
1	Nothing	....	....	1,070	17.8	....
2	Nitrate of Soda	150 lbs.	$4.50	1,320	22.0	4.0
3	Superphosphate	350 "	5.25	1,400	23.3	5.3
4	Muriate of Potash	150 "	3.25	1,800	30.0	12.0
5	Nitrate of Soda Superphosphate	150 350 "	9.75	1,650	27.5	9.5
6	Nothing	....	....	1,120	18.6	....
7	Nitrate of Soda Muriate of Potash	150 150 "	7.75	1,510	25.2	7.2
8	Superphosphate Muriate of Potash	350 150 "	8.50	3,020	50.3	32.3
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 " 150	13.00	2,210	36.9	18.9
10	Plaster	400 "	1.50	1,610	10.1	–8.0
11	Fine Barn-yard Manure	20 2-horse loads.	30.00	5,420	90.3	72.0

These experiments were made in the summer of 1883 upon the red soil which overlies the red sandstone and red shale rocks, and is undoubtedly produced by their disintegration. It possesses the same characteristics in composition, texture and adaptation to farm crops. Good crops of potatoes are not usually grown upon this soil. This is probably due to the closeness of texture of the subsoil, and not to any defect in its chemical composition. In the places where there is an open, gravelly or sandy subsoil, so that the ground is thoroughly and quickly drained, good crops of potatoes can be grown. This soil of Mr. Thompson's is of fair quality, and yields good average crops of grass, corn, timothy, oats and wheat. Last year it was in corn, and suffered severely from drought, but the plot which then produced 36 bushels of corn per acre without any manure, only yielded 18½ bushels of potatoes this year, and that which, with a complete mineral manure, yielded 47 bushels of corn last year, only yielded, with the same manure, 37 bushels of potatoes this year. And the plot which had at the rate of 20 two-horse loads of manure both last year and this, yielded 38½ bushels of shelled corn per acre then, only yielded 90 bushels of potatoes this year.

There does not appear to have been any profit derived from the use of nitrate of soda, either singly or when mixed with other manurial elements.

The muriate of potash has paid its cost when applied singly, but mixed with superphosphate of lime the benefits have been much greater.

The barn-yard manure has produced the largest yield, and if allowance is made for the portion of it not lost in growing the crop, it has probably yielded the most profit.

A good dressing of barn-yard manure, and then an application of muriate of potash and superphosphate of lime, give promise of being the best manure for potatoes on this soil. But much skill is needed to meet the difficulties presented by this soil for cultivating potatoes. The driest and best-drained fields should be selected for this crop.

FIELD EXPERIMENTS WITH FERTILIZERS ON SWEET-POTATOES.

By A. P. Arnold, Vineland, Cumberland County, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.					Value per Acre of Crop.	Gain or Loss per Acre
	Kind.	Weight per Acre.	Cost per Acre.	Number of Pounds Good.	Number of Pounds Poor.	Number of Bushels Good.	Number of Bushels Poor.	Total Number of Bushels.		
1	Nothing............	....	....	1,250	1,670	25	33.4	58.4	$25.85	....
2	Nitrate of Soda....	150 lbs.	$4.50	1,290	1,510	25.8	30.2	56.0	25.61	—$6.35
3	Superphosphate...	350 "	5.25	1,470	1,870	29.4	37.4	66.8	29.93	—2.78
4	Muriate of Potash.	150 "	3.25	3,640	1,090	72.8	21.8	94.6	56.41	+25.70
5	Nitrate of Soda.... Superphosphate...	150 350 "	9.75	1,600	1,640	32.0	32.8	64.8	30.60	—6.61
6	Nothing............	....	....	1,530	1,530	30.6	30.6	61.2	29.07	....
7	Nitrate of Soda.... Muriate of Potash.	150 150 "	7.75	3,250	1,430	65 0	28.6	93.6	52.65	+17.44
8	Superphosphate... Muriate of Potash.	350 150 "	8.50	4,030	1,860	80.6	37.2	107.8	65.77	+29.81
9	Nitrate of Soda.... Superphosphate... Muriate of Potash.	150 350 " 150	13.00	4,640	2,160	92.8	43.2	136.0	75.76	+35.30
10	Plaster...............	400 "	1.50	820	1,720	16.4	34.4	50.8	20.08	—8.88
11	Fine Barn-yard Manure.	20 two-horse l'ds	30.00	5,400	1,770	108.	35.4	143.4	85.45	+27.99

This is the second experiment in this series, corn having been grown on these plots last season.

The weather was decidedly unfavorable, reducing the total crop on this farm to about one-third of what it should have been; extreme drought at the "setting" time causing a total failure to be feared.

The above results showing that potash yields the largest returns for the smallest outlay, corroborates the conclusions from several previous experiments made by Mr. Arnold. Wherever it was used the total yield was increased, and the percentage of poor potatoes decreased.

The comparison between yard manure and the complete fertilizer, No. 9, is decidedly in favor of the latter; the total profit was larger, while the amount of money invested was less than one-half.

The potatoes from the manured plot were inferior in quality to those grown with artificial fertilizers.

Mr. Arnold concludes that, while potash alone gave favorable returns, a complete fertilizer is to be preferred, as he believes that subsequent crops will be more favorably influenced by this treatment.

FIELD EXPERIMENTS WITH FERTILIZERS ON CLOVER.

By Stephen C. Dayton, Basking Ridge, Somerset County, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.		
	Kind.	Weight per Acre.	Cost per Acre.	Pounds per Acre, 1st Cut.	Pounds per Acre, 2d Cut.	Total Weight per Acre.
1	Nothing			260	730	990
2	Nitrate of Soda	150 lbs.	$4.50	260	800	1,060
3	Superphosphate	350 "	5.25	3,050	2,650	5,700
4	Muriate of Potash	150 "	3.25	280	860	1,140
5	Nitrate of Soda Superphosphate	150 350 "	9.75	3,200	2,700	5,900
6	Nothing			260	720	980
7	Nitrate of Soda Muriate of Potash	150 150 "	7.75	380	950	1,330
8	Superphosphate Muriate of Potash	350 150 "	8.50	4,850	3,650	8,500
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 " 150	13.00	4,950	3,900	8,850
10	Plaster	400 "	1.50	320	900	1,220
11	Fine Barn-yard Manure	20 2-horse loads.	30.00	4,900	4,300	9,200
12	Lime	50 bushels.		2,000	2,900	4,900

The above experiment is the third in the series, as the same fertilizers have been, on two preceding years, applied on the same plots. This field lies on a trap-rock soil, and is described as nearly barren, unless fertilized.

In 1881 the effect of phosphoric acid on corn was very noticeable, doubling the yield from unmanured plots; all combinations also into which phosphoric acid entered yielded in every case two and three times as much as those without it.

In 1882 the effect of phosphoric acid on oats was equally marked, both quality and quantity being improved.

Combinations with phosphoric acid yielding twice as much as those without.

A measured bushel, from plots fertilized with this acid, weighed in every case thirty pounds or more, and from every plot without it a measured bushel in no case weighed twenty-six pounds.

In 1883, on clover, the same remarkable results are obtained; phosphoric acid again influencing the yield in an unexpected manner. Plots fertilized with this acid yielding from four to nine times as much clover hay as those without it.

Mr. Dayton calls particular attention to the yield of two and one-half tons of hay per acre, caused by a single application of fifty bushels of lime made three years ago.

FIELD EXPERIMENTS WITH FERTILIZERS ON WHEAT.

By Dr. C. W. Larison, Ringoes, Hunterdon County, N. J.

Number of Plot.	FERTILIZERS.			Yield per Acre.			Pounds per Measured Bushel.
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Wheat.	Bushels of Wheat.	Pounds of Straw.	
1	Nothing			450	7.5	720	56.5
2	Nitrate of Soda	150 lbs.	$4.50	350	5.8	470	56.
3	Superphosphate	350 "	5.25	730	12.2	1,140	56.
4	Muriate of Potash	150 "	3.25	505	8.4	1,010	56.
5	Nitrate of Soda Superphosphate	150 350 "	9.75	965	16.1	1,405	56.5
6	Nothing			405	6.8	535	56.
7	Nitrate of Soda Muriate of Potash	150 150 "	7.75	560	9.3	640	56.
8	Superphosphate Muriate of Potash	350 150 "	8.50	920	15.3	1,480	57.
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 150 "	13.00	920	15.3	1,200	57.
10	Plaster	400 "	1.50	500	8.3	1,010	56.
11	Fine Barn-yard Manure	20 2-horse loads.	30.00	1,150	19.2	1,750	57.

This is also the third experiment in the series, corn and oats having been grown on these plots during the two preceding years.

The soil is described as a sandy loam, loose and friable.

As this field lies upon a ridge 325 feet above the sea level, good drainage is insured.

Red stem was the variety of wheat sown.

In 1881 experiments with corn were carried out on these plots.

Combinations of phosphoric acid in all cases influenced the yield more favorably than those without it.

In 1882 the action of phosphoric acid, used alone, was more favorable than any other fertilizing element; but the combination of nitrate of soda and muriate of potash equalled or excelled all other mixtures.

In 1883 phosphoric acid influenced the yield, both of grain and straw, in a very marked manner.

As the above table shows, plots 3, 5, 8, 9 and 11, on which it was used, gave, in some cases, twice as much grain as plots fertilized with nitrogen or potash.

The total yield, however, was in no case large enough to admit of financial gains.

NITRATE OF SODA, OR CHILI SALTPETRE, AS A TOP-DRESSING FOR WHEAT.

Present market prices warrant the Station in recommending nitrate of soda as a valuable top-dressing for wheat.

For nearly fifty years it has been used for this purpose in England, and, as a recent field experiment on the College Farm shows, it is well worthy of a trial by the farmers of this State. In this experiment it increased the yield of wheat from 27 bushels per acre to 34 bushels; it increased the weight of straw by nearly 1,600 pounds, and, as far as can be judged at present, favorably influenced the growth of clover and timothy.

Abstracts from the Journal of the Royal Agricultural Society of England will show most clearly the benefits to be gained by this top-dressing, and at the same time will indicate the losses which may result from its improper use. The history of its introduction among English farmers is the usual record of financial gain to those who understand how to take advantage of the experience of others, and financial loss to those who could learn only by personal failures.

The first ship load of nitrate of soda reached London in 1820, but buyers could not be found, and at last its discouraged owners threw the entire cargo into the river, in order to avoid custom house expenses. Ten years later a second cargo proved a loss to its importers, an indication that successful field experiments with this salt, published in 1828, were either unknown or not understood by those most concerned.

In 1838, 1839 and 1840, experiments proved that 100 weight of nitrate of soda increased the yield of wheat by from four to six bushels per acre. Hannman, in 1842, reports that 140 pounds used as a top-dressing, in May, caused an increase from twenty-nine bushels per acre to thirty-five bushels. This report doubtless attracted attention and led to other experiments, all of which, however, did not terminate favorably. Complaints were heard that in dry seasons nitrate of soda burned the young plant, while in wet seasons an excessive development of straw followed its use, and in consequence the grain often lodged and mildewed. Another serious objection was that it caused the wheat to ripen late and imperfectly.

These results led farmers to regard nitrate of soda with distrust, considering it a "thoroughly unmanageable manure." Its value was recognized, however, and means were sought for overcoming its defects. In 1852 Mr. Pusey announced that a remedy was known; that a Mr. Blyth, of Sussex, had successfully used, for ten years, a mixture of nitrate of soda and common salt as a top-dressing for wheat. Reports of trials made, in 1850 and 1851, by Mr. Keary, also bear witness to the value of this mixture. On his farm an increase from 37 bushels per acre to 45 bushels followed the application of 100 weight of nitrate of soda, mixed with 200 weight of salt. The same result was again obtained on repeating this experiment in 1851. The confidence of this experimenter in his own work is shown by the fact that he then used this mixture on nearly 400 acres of wheat, with an average gain of six bushels per acre. Mr. Keary's positive statement is also on record, that he has never met an instance where nitrate, properly used, failed to repay a heavy percentage on the investment.

Dr. Voelckert, chemist of the English Agricultural Society, repeated, in part, Mr. Keary's experiment, and obtained in 1859 an increase of thirteen bushels, and in 1860 an increase of thirteen bushels, and in 1861 an increase of fourteen bushels of wheat per acre. Dr. Voelckest used about 175 pounds of nitrate of soda as a top-dressing in the spring.

In 1859 he mixed the nitrate with an equal weight of salt, but in 1860 and 1861 the mixture was one-third nitrate and two-thirds salt.

Salt, however, was not the only remedy proposed. Mr. Garnet, in 1853, claimed that soluble silicate of soda, mixed with nitrate of soda, gave profitable returns, and more recent experiments teach that an acid phosphate may also be used in the place of salt, and from a theoretical standpoint, at least, is to be preferred. In trials made in 1869, under Dr. Voelckert's directions, on four different farms, nitrate of soda was used alone in some cases, and in other cases combined with an acid phosphate. On two farms the phosphate had no marked effect; on the third it was regarded as profitable, while on the fourth farm the increase caused by its use was considerable. In all of these cases the acid phosphate was applied as a top-dressing, a course regarded at present by some experimenters as irrational. In German field trials, conducted by Professor Maercker, the acid phosphate was drilled with the wheat, a plan which is thought to insure a thorough distribution of phosphoric acid in the soil. No mention is made in either of the above reports of the young plants having been damaged by the top-dressing, or of the grain lodging or ripening late; although Dr. Voelckert used in some cases 336 pounds of the nitrate per acre, a very heavy dressing, but one which, on this farm, yielded an increase of more than fifteen bushels of wheat per acre.

Professor Maercker's experiments were aimed to learn *when* the nitrate of soda should be used as a top-dressing; reports from five different farms show most favorable results following the application late in March and early in May; the average increase of grain was 36 per cent. With a few exceptions, Dr. Voelckert's experiments also indicate that March and April are more favorable for top-dressing wheat than earlier dates.

In the experiment last season on the College Farm, 350 pounds of acid were drilled in with the wheat. About the middle of April, 275 pounds of nitrate of soda were spread broadcast on one acre, while a second was not top-dressed. The yield of grain and straw was in each case as follows:

	GRAIN.	STRAW.
Top-dressed	34 bushels.	3,227 lbs.
Not top-dressed	27 "	1,634 "

The weight of a measured bushel of wheat was in each case sixty pounds.

The following analyses show that in the experiment, quantity was not gained at the expense of quality:

	GRAIN.		STRAW.	
	With Nitrate.	Without Nitrate.	With Nitrate.	Without Nitrate.
Moisture, per cent	13.38	14.02	10.06	9.11
Crude Fat, per cent	1.73	1.56	1.70	1.78
Crude Fiber, per cent	1.86	1.90	38.93	38.36
Crude Proteine, per cent	11.50	10.93	1.81	1.50
Ash, per cent	1.83	1.88	2.89	3.42
Carbhydrates, per cent	69.70	69.71	44.61	45.83

A study of the field experiments made during the past fifty years warrants the following statements:

Nitrate of soda, judiciously used as a top-dressing, will generally give a profitable increase both of wheat and straw.

If an acid phosphate has been drilled with the wheat, nitrate of soda can be used alone, mixed with twice its own weight of dry soil. To insure a perfect mixture with this soil, it is necessary to break all large lumps and pass the nitrate through a coarse sieve. If an acid phosphate has not been drilled with the wheat, English experience teaches that it is best to mix the sifted nitrate with twice its own weight of sifted salt.

From 100 to 150 pounds of nitrate of soda per acre will probably, in most cases, be a sufficient dressing; larger quantities in some cases have materially increased the profits.

The best time to use nitrate of soda is probably soon after vegetation begins in the spring, care being taken not to delay too long, as there is danger that late dressing will delay or cause imperfect ripening of the grain.

If possible, the nitrate should be spread just before a light rain; this will distribute it in the soil and aid in preventing it from damaging the young plants.

If wheat has been injured by a severe winter, or if, from any reason, it appears yellow and sickly in the spring, it is claimed that a light dressing of nitrate of soda will often prove a serviceable remedy.

Farmers in this State, particularly those who used phosphate only on their wheat last fall, are advised to give this top-dressing a careful trial. All possible information will be furnished by the Station on application.

RESULTS OF FIELD AND LABORATORY EXPERIMENTS WITH SORGHUM FOR THE SEASON OF 1883.

The experiments made in 1881 and 1882 were repeated in 1883. They were planned to show—

First. The effect of fertilizers upon the formation of sugar in sorghum.

Second. To prove that by the present process of extraction more than one-half of the sugar formed in the plant may be wasted; that even when a mill yields from fifty to sixty per cent. of juice, it may still leave more sugar in the bagasse than it extracts from the cane.

The plots selected on the College Farm for this experiment formed a portion of a uniform field of twelve acres, which had been in grass during three previous years. Ten acres of this field, dressed with barn-yard manure, produced 700 bushels of shelled corn, an indication that the season was favorable and that the soil was extremely fertile.

The sorghum ground was first prepared as if intended for Indian corn and then staked out into sixteen plots, each one-tenth of an acre. The fertilizers were spread broadcast and harrowed in. The quantities and combinations used on each plot, as well as the cost of the material, can be found in the table. As in former experiments, phosphoric acid was used in the form of bone black superphosphate, and nitrogen in the form of nitrate of soda. Muriate of potash was applied to some of the plots and sulphate of potash to others. Two tons of yard manure were spread upon plot 11, and forty pounds of gypsum, or land plaster, upon plot 10. Two plots, 1 and 6, were left without fertilizers in order to learn what the soil alone was able to produce.

On the 19th of May, Early Amber* seed was planted in rows three feet eight inches apart. The plants were thinned out as much as was necessary and cultivated twice during the season; late cultivation, however, was avoided, as this is believed to have prevented seed development in a former experiment.

The fertilizers exerted no perceptible effect on the growth of the plants. Those upon plots 1 and 6 appeared at all times to flourish quite as well as any on the rest of the field. At the close of the experiment there were also no marked differences, except perhaps in case of plot 11, on which the canes seemed rather unripe, although their seed was well developed and hard.

Samples of cane for analysis were secured from each plot during the last week in September. Some of these samples weighed nearly ninety pounds each, from two to three per cent. of the cane grown on a plot. To obtain such samples, two average canes were cut from every row. In other cases the samples weighed about forty pounds, one cane only being taken from each row.

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* In Cape May county, the Early Orange cane is now preferred. It is heavier and more stocky than the Amber, and stands up better under the effects of wind and rain. The Orange matures later than the Amber, and may for this reason be less suitable in sections of the State liable to early frosts.

After the leaves and seed-tops were removed, each sample was divided into two portions, one of which was immediately ground in a heavy mill and the weighed juice thoroughly mixed and analyzed. The results are tabulated as *extractable sugar per acre.* The remaining portion of each sample was passed through a Lion fodder cutter and carefully mixed. A subsample was then taken, dried as rapidly as possible, and ground to a fine meal. From this meal the sugar was extracted with boiling alcohol and determined by means of the polariscope. The results are tabulated as *total amount of sugar per acre.*

Clerget's method of using the polariscope was followed in all determinations of sugar published in this bulletin.

The action of the fertilizers may be studied from three standpoints:

First. What fertilizing element exerted most marked influence on sugar production?

Second. For sugar development in sorghum is the sulphate or muriate of potash to be preferred?

Third. Has phosphoric acid hastened to any noticeable extent the ripening of the plant?

By studying in the table the *total amount of sugar per acre,* it will be seen that with one exception potash was present in every case where the yield of sugar was 4,000 pounds or more per acre. The exception is found in the land plaster, plot No. 10. The action of this material is believed by many to lie chiefly in its power of making potash, which is stored in the soil, available for plant food. If this field, therefore, had been deficient in potash, the plaster would probably have been much less serviceable.

Potash used alone developed more sugar per acre than any other single material. Compare plots 4 and 12 with 2 and 3. Potash, combined with nitrogen, gave in both cases the highest yields of sugar obtained: on plot 7, 4,582 pounds, and on plot 14, 4,866 pounds per acre. The yield of sugar was relatively low wherever phosphoric acid was used, and its yield was considerably diminished when the amount of phosphoric acid was doubled. Compare plots 15 and 16. The conclusion, then, from this experiment is, that *potash was the element which influenced sugar production in sorghum most favorably, but that the highest yield per acre was obtained when potash was used in combination with nitrogen.*

In every case sulphate of potash surpassed muriate of potash in *developing sugar in sorghum.* Compare, *under total amount of sugar per acre,* plot 4 with 12, plot 7 with 14, plot 8 with 13, and plot 9 with 15. That sulphate of potash is to be preferred in cultivating beets for sugar and potatoes for starch, has been known for a number of years; but if the same observation has been already made in the case of sorghum, it has escaped notice.

It was expected that the cane on the several plots would show marked differences in the time of ripening seed. This was to have been the standard for measuring the power of phosphoric acid to shorten the period of growth of sorghum. Conclusions on this point cannot, however, be drawn from this experiment, as the cane on all the plots matured seed at about the same time. At the Rio Grande plantation, where the season has been wet and unfavorable, fields fertilized with phosphoric acid matured earlier than those without it—an experience which corresponds with the practice in some sugar-beet districts, where land from which the crop is to be taken in September is dressed with twice as much superphosphate as that which is to be left until October.

One more point deserves notice in connection with study of fertilizers: *quantity of cane alone is no index to the value of a fertilizer as a sugar developer in sorghum.* In this experiment, the heaviest yields of cane were from plots 11 and 4, 19.3 tons and 19.7 tons, respectively, while plots 15 and 16 each gave three tons less per acre. In spite, however, of the smaller quantity of cane, plots 15 and 16 each produced from 300 to 400 pounds more sugar per acre than plots 11 and 4.

Even when a mill expresses from fifty to sixty per cent. of juice from stripped and topped cane it may yet leave more than one-half of the sugar in the bagasse. This fact can be best shown by an example. The cane on plot 11 contained 4,119 pounds of sugar per acre. Of this the mill expressed 1,983 pounds, leaving in the bagasse fifty-two per cent. of the sugar which the cane contained. This result is the most favorable in the experiment. The other extreme is found on plot 10, where nearly seventy per cent. of the sugar was wasted. In eleven other cases the loss exceeds sixty per cent. Apparently, the greener the cane the smaller the loss of sugar by the milling process.

To explain this loss it is necessary to assume that a considerable portion of the sugar is stored in the cane in a solid state, either as pure crystallized sugar or in some combination easily decomposed or dissolved in water. It is claimed that the microscope has shown crystals of sugar in the cells of the sorghum; if this is true, it is irrational to attempt the perfect separation of sugar from the cane fiber by mechanical means. For attaining this end the process of diffusion seems to be the most practical and promising method. It has been thoroughly tested and generally adopted by the beet-sugar industry, and experiments thus far reported indicate that it is also applicable to the sorghum and tropical cane.

Mr. H. B. Blackwell states in the Boston *Journal of Chemistry* that, by following this process, he was able, without difficulty, to make thirteen pounds of crystallized sugar and six pounds of good syrup from 100 pounds of Amber cane.

This process, as followed in the beet-sugar industry, is explained in detail in Stohman's Hand Book. In brief, it is as follows: The beets, cut into small strips, are placed in a steam-tight iron tank. Steam at a certain temperature is then allowed to act long enough to destroy the vitality of the plant cells, when a quantity of water, about equal to the weight of beets taken, is forced into the tank from below and kept in contact with the beet strips for about ten minutes. During this time two or more of the eleven other tanks in the battery are stocked with "strips" and steamed. The dilute sugar solution now in the first tank is next forced up through the beets in the second tank, where it becomes still richer in sugar. In turn it is pressed through eight other tanks, becoming more and more charged with sugar from repeated contact with fresh beets, and is finally forced into the defecator as rich almost as juice from the same beets would be if expressed with hydraulic presses. The amount of water to evaporate is not, therefore, materially increased.

When the dilute sugar solution is pressed out from the first tank, fresh water immediately takes its place, and when the sugar solution is sent to the defecator the "strips" in the first tank have been leached ten times with fresh water and practically all the sugar extracted. The tank is then refilled with fresh beets and takes its place again in the battery, as No. 10. The process is thus made continuous. One tank is always being emptied and cleaned, another being refilled, while the remaining ten are in operation. One boy to manage the valves, two men to fill the tanks and two to empty and clean them is the necessary working force.

Recently it has been reported that a careful test of this process on sorghum is now in progress at the Department of Agriculture in Washington. The results, it is stated, will be published in January.

The yield of clean, dry seed has been unusually high, from twenty-five to thirty-nine bushels per acre. As feed for milch cows sorghum-seed meal has been already proven little, if any, inferior, pound for pound, to corn meal. For growing and fattening swine, the boiled cane seed gives perfect satisfaction. Three hundred pigs and hogs are now penned on the Rio Grande plantation and fed entirely on bagasse and boiled seed. Arrangements are being made to increase the number eventually to 1,000. It is expected that these waste products from the sugar-house with the seed will fatten pork enough to pay the expenses of planting and cultivating 1,000 acres of cane.

SORGHUM.

KIND AND QUANTITY OF FERTILIZERS USED PER ACRE.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
							Potash as Muriate.					Potash as High Grade Sulphate.				
	Nothing.	Nitrogen, 22½ lbs.	Phos. Acid, 52½ lbs.	Potash, 75 lbs., from Muriate of Potash.	Nitrogen, 22½ lbs. Phos. Acid, 52½ lbs.	Nothing.	Nitrogen, 22½ lbs. Potash, 75 lbs.	Phos. Acid, 52½ lbs. Potash, 75 lbs.	Nitrogen. 22½ lbs. Phos. Acid, 52½ lbs. Potash, 75 lbs.	Land Plaster, 400 lbs.	Nitrogen, 204 lbs. Phos. Acid, 164 lbs.* Potash, 200 lbs.	Potash, 80 lbs.	Phos. Acid, 52½ lbs. Potash, 80 lbs.	Nitrogen. 22½ lbs. Potash, 80 lbs.	Nitrogen, 22½ lbs. Phos. Acid, 52½ lbs. Potash, 80 lbs.	Nitrogen, 22½ lbs. Phos. Acid, 105 lbs. Potash, 80 lbs.
Cost of Fertilizers per acre	....	$4.50	$5.25	$3.25	$9.75	....	$7.75	$8.50	$13.00	$1.50	?	$5.60	$10.85	$10.10	$15.35	$20.60
Pounds of Sorghum per acre	31040	31930	35200	39390	33580	33220	36780	33680	32860	32820	38590	36740	29790	36320	33600	33180
Tons of Sorghum per acre	15.5	15.9	17.6	19.6	16.8	16.6	18.4	16.8	16.4	16.4	19.3	18.4	14.9	18.2	16.8	16.6
Percentage of Leaves	8.6	8.	4.6	6.3	6.7	8.1	8.2	7.2	8.8	7.6	6.5	6.4	9.1	8.	8.7	6.6
Per cent. of Stripped and Topped Cane	83.9	84.5	83.9	85.7	85.3	82.5	83.	84.5	82.7	84.5	84.8	85.1	83.1	84.1	84.1	84.5
Pounds of Stripped and Topped Cane per acre	25730	26980	29530	33760	28600	27410	30530	28460	27180	27730	32720	31270	24860	30550	28260	28040
Per cent. of Sugar in Stripped and Topped Cane	15.05	13.13	12.97	11.74	11.40	12.50	15.01	11.79	12.70	15.20	12.59	13.57	15.42	15.93	16.09	15.37
Total amount of Sugar in pounds per acre	**3872**	**3542**	**3830**	**3963**	**3260**	**3426**	**4582**	**3355**	**3452**	**4215**	**4119**	**4243**	**3833**	**4866**	**4547**	**4309**
Amount of Extractable Sugar in pounds per acre	1362	1513	1493	1558	1458	1190	1634	1537	1343	1302	1983	1701	1343	1663	1563	1503
Per cent. of total Sugar lost in Bagasse	64.8	57.3	61.	60.7	55.3	65.3	64.3	54.2	61.1	69.1	51.9	60.	65.	65.8	65.6	65.1
Per cent. of Juice extracted from Stripped and Topped Canes	57.6	58.6	58.8	58.8	57.1	54.3	60.	57.1	56.6	58.1	57.9	56.1	51.6	58.9	51.2	52.3
Per cent. of Sugar in Juice	9.19	9.57	8.60	7.85	8.93	8.	8.92	9.33	8.78	8.08	10.47	9.70	10.51	10.10	10.80	10.25
Bushels (56 pounds) of Clean, Dry Seed per acre	31.6	26.1	33.9	39.1	32.9	30.8	36.7	33.7	32.8	30.	33.	34.	25.	33.	27.6	29.6

* Twenty (20) Tons Barn-yard Manure.

FODDERS AND FEEDS.

Analyses of fodders and feeds, made during the past season, are given below. In one table can be found samples of green fodders and ensilage; in the other, samples of cotton-seed meal, brewers' grains and similar waste products from various manufactures.

The following description is taken from the last annual report of this Station. In the analysis, the ingredients of fodders are separated into the five following classes:

CRUDE PROTEINE, CRUDE FAT, CRUDE FIBER, CARBHYDRATES, ASH.

The term *proteine* is used to designate a group of compounds, some of which are well known. The elastic substance which remains when wheat flour is kneaded under water, is, for example, a member of this class; its specific name is gluten. The white solid in a hard-boiled egg is another member of this class, and is known as albumen; when fresh blood is whipped with a bundle of twigs it coagulates, the red coloring matter can then be washed out, and the white solid remaining is a third member of the class, known under the name of fibrin.

Gluten, albumen and fibrin, while differing widely in appearance, agree closely in chemical composition, each having, in a pure and dry condition, sixteen per cent. of nitrogen; this percentage of nitrogen is the characteristic feature of this class. Fodders and feeds, without exception, contain some member of this group; but as the labor of separating the compound is in many cases considerable, and in some cases excessive, the usual plan of making an analysis is simply to determine the percentage of nitrogen, and from this, calculate the proteine.

The class of compounds known as *fats* also differ widely in appearance; butter, lard and tallow being solid at ordinary temperatures, and olive and cotton-seed oil fluid. In chemical composition all are closely allied, and while insoluble in water, are all readily soluble in certain re-agents, as ether, &c. In fodder analysis all substances soluble in ether are grouped as *crude fat.*

Paper pulp and cotton lint are two of the best examples of the class *crude fiber*, and sugar and starch of the class *carbhydrates.*

Ash signifies the residue remaining when a fodder or feed has been burned. It contains the mineral matters extracted by the growing plant from the soil, and in composition varies, of course, with the nature of the fodders. Without exception, however, it contains phosphoric acid, potash, lime, magnesia, soda, sulphuric acid, &c.—all substances indispensable to animal life.

The examination of the solid excrement of animals invariably shows the presence of proteine, fat and carbhydrates, which have passed undigested through the body. This loss of food is dependent upon the nature of the fodder, its mechanical condition and upon the proportion existing between the proteine and carbydrates in the ration. In the following table the amount of digestible food has been calculated in each sample, on the supposition that the fodder was in the best possible mechanical condition and was fed in proper quantities. To make a striking comparison between the fodders and feeds tabulated, the plan adopted in the fertilizer control has been followed. Money values have been assumed, and the various fodders compared on this standard.

Digestible proteine and fat are valued at four and one-third cents, and digestible carbhydrates at nine-tenths of one cent per pound.

Brewers' grains at six cents per bushel, furnish proteine and fat for about a cent and one-half per pound. In *cotton-seed meal* at twenty-six dollars per ton, proteine and fat cost two and one-third cents per pound, while in corn meal at thirty dollars per ton, proteine and fat cost six and one-quarter cents per pound, and in timothy hay the price is still higher.

Another practical use for which fodder analyses are valuable, is in making up rations. For milch cows, experience teaches that two and one-half pounds of digestible proteine, four-tenths of a pound of fat, and twelve and one-half pounds of digestible carbhydrates daily are sufficient for each 1,000 lbs. of live weight. This food, however, must be contained in not more than twenty-five pounds of dry matter.

The following rations, in some cases made entirely from waste products, have been tested on the College Farm and found satisfactory:

I.

30 pounds of brewers' grains.
3 pounds of wheat bran.
20 pounds of dried corn fodder.

II.

50 pounds of corn ensilage.
3 pounds of bran.
30 pounds of brewers' grains.

III.

10 pounds of timothy hay.
4 pounds of corn meal.
3 pounds of oil-cake meal.
20 pounds of brewers' grains.

IV.

50 pounds of green rye.
3 pounds of bran.
27 pounds of brewers' grains.

In either of the above rations one pound of cotton-seed meal can be substituted for three pounds of bran.

The milk from the College Farm is sold direct to city consumers, and in all probability none of it is churned. The effect of brewers' grains on the color and firmness of the butter is, therefore, in this case, not as important as it would be where butter alone is retailed. The above rations are recommended, therefore, to those dairies from which whole milk only is sold direct to consumers.

A company of capitalists are now drying brewers' grains in New York by a patented process. A quantity of these dried grains has been stored for some time on the College Farm; a feeding trial having been planned to compare them with moist grains from a silo. A quantity of new process oil-cake meal is also on hand to be compared with the product from the old process. Both of these trials will soon be commenced.

FOODS AND FODDERS.

Station Number.	BRAND.	POUNDS PER HUNDRED OF— Water.	Crude Fat.	Crude Fiber.	Crude Ash.	Proteine.	Carbhy-drates.	IN ONE HUNDRED POUNDS OF FEED, NUMBER OF POUNDS OF DIGESTIBLE— Crude Fat.	Crude Fiber.	Proteine.	Carbhy-drates.	COST PER POUND OF DIGESTIBLE— Crude Fat.	Proteine.	Carbhy-drates, includ'g Fiber.	Estimated Value per 100 lbs.	Market Price per 100 lbs.	Phosphoric Acid.	Potash.	Station Number.
164	Cotton-Seed Meal........................	6.65	10.24	4.30	7.71	43.69	27.41	9.01	....	37.18	26.04	2.32c	2.32c	0.65c	$2.22	$1.30	3.47	1.92	164
134	" " "	6.89	13.12	8.05	7.80	42.56	21.58	11.54	....	36.18	20.50	2.88	2.88	0.60	2.25	1.50	3.56	2.01	134
168	Ground Linseed Cake..................	10.34	6.06	9.86	5.87	34.98	33.44	5.51	2.43	30.89	30.43	3.84	3.84	0.80	1.86	1.61	2.28	1.51	168
162	Linseed Meal (new process)........	9.90	3.56	9.00	5.56	34.56	37.42	3.24	3.34	30.07	34.05	....	....	....	....	....	2.13	1.50	162
142	Dried Brewers' Grains................	6.43	6.01	11.20	3.82	20.19	52.85	....	....	17.16	52.85	3.02	3.02	0.63	1.42	1.00	....	....	142
150	Starch Feed, Dried and Ground..	9.30	7.86	5.12	0.90	14.18	62.69	6.68	3.17	11.16	57.05	3.79	3.79	0.79	1.31	1.15	....	....	150
138	Winter Wheat Bran......................	13.60	3.51	7.24	5.79	18.87	55.99	2.81	1.45	12.21	44.79	4.46	4.46	0.93	1.05	1.10	....	....	138
139	Brewers' Grains............................	71.54	2.18	3.10	1.16	6.30	15.78	1.74	....	5.36	15.78	1.54	1.54	0.32	0.43	0.16	....	....	139
149	Starch Waste................................	64.98	[illegible]	2.83	0.27	5.81	22.78	2.87	1.75	4.59	20.68	3.50	3.50	0.73	0.52	0.42	....	....	149
145	Brewers' Grains, from Silo..........	71.50	1.88	4.11	1.30	5.49	15.71	1.50	....	4.67	15.71	1.72	1.72	0.36	0.41	0.16	....	....	145
143	Wheat Straw................................	5.38	2.34	40.66	3.67	1.88	46.07	0.63	21.14	0.49	18.43	3.74	3.74	0.77	0.41	0.35	....	....	143
154	" "	10.06	1.70	38.98	2.89	1.81	44.61	0.46	20.24	0.47	17.84	3.89	3.89	0.81	0.38	0.35	....	....	154
155	" "	9.11	1.78	38.36	3.42	1.50	45.83	0.47	19.95	0.39	18.33	3.94	3.94	0.82	0.38	0.35	....	....	155
156	" "	8.54	1.98	37.00	3.43	1.88	47.72	0.52	19.24	0.36	19.09	3.94	3.94	0.82	0.38	0.35	....	....	156
165	Rice Bran......................................	9.00	9.07	13.00	9.22	12.62	47.09	7.26	2.60	11.11	37.67	4.13	4.13	0.86	1.14	1.10	....	....	165
74	Field Corn Stalks........................	12.25	1.50	30.94	5.39	4.06	45.86	1.12	22.27	2.96	30.72	2.82	2.82	0.48	0.65	0.35	....	....	74
78	Corn Meal....................................	12.75	4.06	1.60	1.48	8.85	71.76	3.45	0.99	6.59	65.30	6.27	6.27	1.30	1.03	1.50	....	....	78
85	Timothy Hay................................	11.96	1.98	34.25	4.28	6.44	41.09	0.91	19.86	3.67	25.88	7.08	7.08	1.47	0.60	1.00	....	....	85

FOODS AND FODDERS.

Station Number.	BRAND.	POUNDS PER HUNDRED OF— Water.	Crude Fat.	Crude Fiber.	Crude Ash.	Proteine.	Carbhydrates.	IN ONE HUNDRED POUNDS OF FEED, NUMBER OF POUNDS OF DIGESTIBLE— Crude Fat.	Crude Fiber.	Proteine.	Carbhydrates.	Estimated Value per 100 lbs.	Phosphoric Acid.	Potash.	Station Number.
92	Green Fodder Corn	74.48	0.23	6.32	1.65	1.95	15.18	0.17	4.55	1.40	10.17	$0.20	....	....	92
93	" " "	78.12	0.29	6.56	1.70	2.08	15.59	0.22	4.72	1.52	10.44	0.21	....	....	93
146	" " "	71.51	0.35	6.77	1.42	1.45	18.50	0.26	4.87	1.06	11.39	0.20	....	....	146
147	" " "	69.11	0.32	8.12	1.56	1.59	19.30	0.24	5.85	1.16	12.93	0.22	....	....	147
132	Corn Ensilage	75.10	0.31	6.23	1.58	1.84	13.98	0.23	4.49	1.34	9.36	0.19	....	....	132
135	" "	77.83	0.26	5.71	1.43	1.61	12.27	0.20	4.11	1.10	8.29	0.18	....	....	135
91	Fodder Rye	78.15	0.20	4.92	1.61	2.77	12.85	0.10	....	1.58	12.85	0.18	....	....	91
141	Rye Ensilage	80.75	0.27	5.76	1.62	2.42	9.18	0.17	....	1.28	9.18	0.15	....	....	141
94	Green Sorghum, Amber	71.26	0.37	5.91	1.29	0.94	20.22	0.31	3.51	0.59	15.84	0.21	....	....	94
148	" " "	75.03	0.25	5.69	0.73	0.45	17.85	0.22	3.41	0.28	13.92	0.18	....	....	148
140	Sorghum Ensilage	77.60	0.42	6.06	1.13	0.94	13.85	0.36	3.64	0.58	10.80	0.17	....	....	140
161	" Leaves, Amber	10.39	1.98	23.73	5.36	9.63	48.91	1.68	14.24	5.80	38.15	0.80	0.52	1.12	161
144	Clover Ensilage	72.60	0.93	8.57	2.69	3.81	11.41	0.66	4.80	2.82	8.79	0.27	....	....	144
137	Fodder Corn (Dried)	38.63	0.61	....	3.95	4.59	50.80	0.46	....	3.03	35.40	0.47	....	....	137
157	Cow Pea Vine (Black)	13.38	2.68	17.96	6.02	18.56	46.40	....	....	....	....	....	0.27	0.88	157
158	" " (Whip-poor-Will)	18.99	2.39	18.51	9.04	14.50	41.57	....	....	....	....	....	0.55	1.92	158
159	Sweet Potato Vine (Yellow)	13.12	1.70	11.87	11.83	15.87	46.10	0.41	4.27	6.46	27.67	0.58	0.60	1.69	159
160	" " " (Red)	17.20	1.21	14.77	8.86	10.56	47.36	0 30	5.32	4.44	28.42	0.51	0.44	1.44	160

ENSILAGE.

During the past four years this Station has devoted considerable time to studying the preservation of green food in silos.

Experiments have been undertaken on corn, clover, rye and sorghum. Some of these have been already reported; others are published on the following pages, and several are not yet completed.

At first the aim was to corrobrate the observations, made elsewhere, that ensilaged corn can be fed in large quantities to milch cows without injury. The results of these trials were decidedly favorable.

The next step was the comparison of dried corn fodder with ensilage. The following conclusions were reached:

Green fodder corn, dried in shocks, was preserved quite as well as that which was packed in a silo.

Dried fodder corn, properly cut and crushed, was eaten by cows with as little waste as ensilage.

In three cases out of four the yield of milk was not increased when ensilage was substituted for dried fodder corn.

In comparative feeding trials the quantity of food given was in each case the same, having been determined by analysis.

Other important results, drawn from these experiments, are as follows:

Eighteen per cent. of dry matter was lost in the process of preserving green fodder corn.

The loss fell entirely upon the class of carbhydrates.

The loss was the same, both when the corn was packed in the silo and also when it was dried in shocks.

The experiments carried out during the past year were planned to test the above conclusions, and also to study the conditions influencing this loss. The details and results are given below:

The corn was cut on the 29th of September, 1882, two days after an unusually heavy rain storm. One half was arranged in shocks to dry, the other half was cut and packed into a small silo. The shocks were weighed late in November, 6,455 pounds of green corn giving 2,345 pounds of dried fodder; a loss in weight of 63.7 per cent. This fodder was then placed under shelter and remained undisturbed until the middle of February, when about 1,000 pounds were cut, ground and sampled for analysis. Samples of the ensilage were also secured, the silo having been opened February 13th. On the 29th of September, while this silo was being filled, portions of the cut corn were, from time to time, packed firmly into a clean oil barrel, which was headed up as soon as it was full. Two small iron tubes were passed through the head of this barrel. One of these served to carry the gas, generated by fermentation, into solutions arranged to absorb it. A mercury gauge, attached to this tube, was used both as an indicator and also as a safety-valve. The other tube was closed at its lower end and extended down into the corn, forming a receptacle, into which a thermometer could at any time be placed.

A pressure pump indicated on the mercury gauge that the barrel and all connections were air-tight, and that gas evolved from the corn could escape only by passing through the proper tube.

Fermentation began during the first 24 hours, but progressed very slowly. The evolution of gas stopped on the fourth day. The temperature of the corn in the center of the barrel varied, meanwhile, by two degrees only. The absorbing solutions showed that 102 grammes, or less than four ounces, of carbonic acid gas had been driven out of the barrel.

From time to time, during the two months following, the barrel was proven, by means of a suction pump, to be air-tight. During this time no further evolution of gas was noted.

In December it was found that 179 pounds of green corn gave 174 pounds of ensilage, the loss being 2.8 per cent.

As the carbonic acid gas driven off weighed but four ounces, the additional loss can be explained only by assuming that the barrel dried out on standing and absorbed moisture from the ensilage. The empty barrel, in fact, at the close of the experiment, had increased in weight by nearly half a pound. How much, therefore, of this recorded loss was moisture and how much was food cannot be determined from weights alone. The analysis of this ensilage, compared with analyses of samples taken as above described, are as follows:

	COMPOSITION OF THE DRY MATTER OF—			
	Green Corn.	Ensilage from Barrel.	Ensilage from Silo.	Field-Cured Corn.
Crude Fat	1.10	1.29	1.22	1.02
" Proteine	7.91	7.69	7.56	7.67
" Ash	6.48	6.60	6.76	6.61
" Fiber and Carbhydrates	84.51	84.42	84.46	84.70
	100.	100.	100.	100.

As stated in a previous report, the term ash includes a class of compounds not subject to loss from fermentation. As the absolute weight, therefore, of the ash, in the above-named experiment, can neither have increase nor diminish, it may be used as a standard in calculating the losses of other classes of compounds.

Reduced to this standard, the above analysis reads as follows:

	Green Corn.	Ensilage from Barrel.	Ensilage from Silo.	Field-Cured Corn.
Crude Fat	1.10	1.26	1.16	1.00
" Proteine	7.91	7.48	7.25	7.51
" Ash	6.48	6.48	6.48	6.48
" Fiber and Carbhydrates	84.51	82.88	81.00	83.00
	100.	98.10	95.89	97.99

This table shows that green corn packed in the barrel and green corn dried in shocks lost two pounds only, out of each 100 pounds of dry matter, while green corn packed in a silo lost four pounds. The probable explanation of this difference is, that the barrel was packed better than the silo.

The conclusions from this experiment are:

Green fodder corn, dried in shocks, was preserved quite as well as green corn packed in a silo.

Green fodder corn can be preserved with a loss of 2 per cent. only of dry matter.

The first result accords well with previous work; the second differs widely from experiments in which the loss was shown to be 18 per cent.

In studying the conditions governing these two series of experiments, the following differences are noticed:

In the experiment which showed a loss of 18 per cent of dry matter, the corn was cut on the first of September, 1881. It was noticeably rich in cane sugar, the unusually dry and warm weather in August being especially favorable for the development of this compound. The mean temperature for September 1st was 76°; the mean for the month, 72.4°.

In the experiment showing a loss of 2 per cent. only of dry matter, the corn was cut on the 29th of September, 1882. This corn was noticeably poor in cane sugar, although the weather in July, August and September was also favorable for its production. The mean temperature for the 29th of September was 55°; the mean for the month of October, 58°.

The following questions will, therefore, be studied in a future experiment, now under consideration:

Does the loss of food in silo and stacks vary with the percentage of sugar in the corn?

As the corn matures, is its sugar changed into some other carbhydrate less liable to loss by fermentation?

Can the differences in the results of the above experiments be credited to differences in temperature at the time the corn was cut?

CLOVER ENSILAGE.

During the past two months nearly 12 tons of second-growth clover ensilage have been fed to milch cows on the College Farm, and, so far, the result has been very satisfactory. About four tons of first-growth clover, now packed in a small silo, will be used in subsequent experiments. One complaint only has thus far been heard against its use; customers reported to the proprietor of a large dairy that the milk was tainted with a disagreeable smell, resembling rancid butter. In all probability, if this, as claimed, was due to the ensilaged clover, it can be avoided by feeding the cows after milking, this being the well-known method to avoid tainting milk with smells peculiar to certain fodders.

SORGHUM ENSILAGE.

Nearly 20 tons of sorghum ensilage were fed on the College Farm during the past season. Considerable annoyance and loss was at first experienced, as the cows wasted large quantities. About four tons of sorghum had been treated with calcium bisulphite, at the time the silo was packed, in the hope of preventing loss of sugar by fermentation. This ensilage proved to be better preserved than the rest, and, from the first, was readily eaten. When this supply was exhausted, ensilaged sorghum, which had been wasted before, was now nearly all eaten.

Thirty tons of sorghum ensilage are at present lying in the silos on the College Farm, one-half of which was treated with calcium bisulphite. This will be used both to determine the loss which is caused by fermentation, and also to determine whether it is eaten by cows as readily as corn ensilage.

On the College Farm sorghum was fed to cows instead of fodder corn. It was full grown and the seeds ripe, but the stalks were passed through our Lion cutter and crusher so as to break up the hard coating of the stalks. It was eaten greedily by the cattle, and without any waste. We judged that the flow of milk was kept up rather better while it was fed than when other fodder was given them.

Mr. Chas. Hunt, of Bridgeton, who has been growing sorghum for making syrup for some years past, says: "I find the bagasse, when crushed with the leaves, is better for horses than hay. For eight consecutive weeks, while grinding, I fed only this to my horses and never had them look or do better, if as well. They are at constant work, and plump and frisky as colts; the work was quite hard, but they never looked weary nor the least out of wind. The cows leave the grass to feed upon the bagasse. Could it be dried for storage I think it would be most acceptable for winter, for they are eager to pick out accidental stalks or leaves of cane which may chance to be among their other feed. Have fed the seed (ground one bushel corn and two of seed) to cows, horses and hogs, since the fall of 1881. During winter, when horses are idle, I give the seed whole."

At the Rio Grande sugar-house the bagasse and the seed are both utilized by feeding them to hogs. When the establishment was visited at the end of October, there were 300 Jersey Red swine in their pens, feeding upon the bagasse, which was thrown to them just as it came from the mill, and on the seed, which was boiled till the grains burst and were completely softened. The animals were too fat, and it was evident that two or three times as many were needed to consume the food that was turned out from these two sources.

FEEDING EXPERIMENT.

Dried Corn Fodder compared with Corn Ensilage.

Feeding experiments published in the spring of 1882, indicated that dried fodder corn properly cut and crushed was eaten without waste, and in the majority of cases influenced the milk yield quite as favorably as corn ensilage.

As this work was completed early in February it is open to the criticism that the fodder corn was not exposed to changes by fermentation as long as it should have been; that the comparison would have been more favorable for the ensilage had the experiment been delayed until later in the spring.

In the following trial, planned to corroborate the previous conclusion, ensilage was fed from the 25th of March to the 14th of April, and dried fodder corn from the 16th of April until the 5th of May.

As in former experiments the rations were calculated to contain two and one-half pounds of digestible proteine, and thirteen and one-half pounds of digestible fat and carbhydrates. This food was found in the following materials:

Daily Ration for 1,000 Pounds Live Weight.

FIRST PERIOD—20 DAYS.	SECOND PERIOD—20 DAYS.	THIRD PERIOD—9 DAYS.
50 lbs. Corn Ensilage........	20 lbs. Dried Corn Fodder........	10 lbs. Timothy Hay.
3 lbs. Wheat Bran..........	3 lbs. Wheat Bran................	4 lbs. Corn Meal.
27 lbs. Brewers' Grains......	27 lbs. Brewers' Grains...........	3 lbs. Oil-Cake Meal.
....	....	20 lbs. Brewers' Grains.

During the first period, when ensilage was fed, the average daily yield of milk was 24.8 pounds per cow. This yield decreased to an average of 22.8 pounds when dried fodder corn was substituted, in the second period, for ensilage. The third ration, made up of material acknowledged to be excellent for milk production, was fed to ascertain how much of this loss was due to the food, and how much to natural changes in the condition of the cows. The average daily yield of milk from this ration was 23.3 pounds per cow, an increase of five-tenths of one pound, or about half a pint. As the following milk record indicates, this increase was due almost entirely to one cow.

Including the results of the first experiment, this conclusion seems warranted:

When the rations contain the same weights of digestible food, ensilage, in the majority of cases, has no more influence on the milk yield than dried fodder corn.

MILK RECORD.

ENSILAGE RATION.			DRIED FODDER CORN RATION.			TIMOTHY, HAY AND CORN MEAL RATION.		
Date	Cow No. I.	Cow No. II	Date.	Cow No. I.	Cow No. II.	Date.	Cow No. I.	Cow No. II.
Mar.			Apr.			May		
25	25.5 lbs.	18.5 lbs	16	26.5 lbs.	22.5 lbs.	6	23.5 lbs.	20.0 lbs.
26	25.0 "	18.0 "	17	27.5 "	23.5 "	7	25.0 "	20.5 "
27	23 5 "	21.0 "	18	25.0 "	22.0 "	8	25.0 "	22.5 "
28	27.0 "	20.5 "	19	24.5 "	20.5 "	9	24.0 "	22.5 "
29	27.5 "	23 0 "	20	24.5 "	23.0 "	10	25.0 "	22.5 "
30	28.0 "	23.0 "	21	26.0 "	22.0 "	11	25.5 "	23.0 "
31	27.5 "	22.5 "	22	25.5 "	18.0 "	12	25.0 "	22.5 "
April			23	24.5 "	20.0 "	13	24.5 "	22.0 "
1	27.0 "	23.0 "	24	24.5 "	20.0 "	14	25.0 "	21.5 "
2	28.5 "	25.0 "	25.	24.5 "	22.0 "			
3	25.0 "	22 5 "	26	24.0 "	21.0 "			
4	28.5 "	25.5 "	27	24.5 "	18.5 "			
5	27.5 "	22.5 "	28	24.0 "	20.5 "			
6	27.0 "	24.0 "	29	24.0 "	21.0 "			
7	28.5 "	24.5 "	30	22.5 "	21.5 "			
8	26.0 "	23.5 "	May					
9	26.5 "	22.5 "	1	23.0 "	21.5 "			
10	27.0 "	23.5 "	2	23.5 "	20.5 "			
11	28.0 "	24.0 "	3	24 5 "	20.0 "			
12	28.0 "	23.5 "	4	24.5 "	21.5 "			
13	26.5 "	23.5 "	5	25.0 "	20.5 "			
Av'r'ge,	26.9 lbs.	22.7 lbs	Av'ge,	24.7 lbs.	21.0 lbs.	Av'ge,	24.7 lbs.	21.9 lbs.
Herd average........		24.8 lbs	Herd average......		22.8 lbs.	Herd average......		23.3 lbs.

GREEN RYE AND RYE ENSILAGE ON DAIRY FARMS.

Dairymen state that a good ration for milch cows can be made by mixing *young rye* with the necessary amount of nitrogenous food. They claim, however, that rye, *after it has headed out*, is worthless as a soiling crop, being then too tough for cows to eat.

A remedy for this trouble is *to cut the rye while it is still tender and pack it away as ensilage.* A supply of green food will thus be secured, and the land on which the rye was grown can be prepared in time to be again planted with either fodder corn or millet.

The desire to obtain the greatest possible yield per acre will prevent farmers from cutting this crop too early in the season. Delaying long on this account is, however, dangerous, as there is no proof that tender ensilage can be made from tough rye. Observations during the past two years indicate that, on the College Farm, the silo should be filled about the 20th of May.

Two feeding experiments with milch cows have been carried out this season; one planned to compare a green rye with timothy hay and corn meal, the other intended to show that rye ensilage is a substitute for green rye.

On the 6th of May, 1883, two cows were selected for these trials. During the first nine days their ration was ten pounds of timothy hay, four pounds of corn meal, three pounds of oil-cake meal and twenty pounds of brewers' grains per cow. This furnished about two and one-half pounds of digestible proteine and thirteen and one-half pounds of digestible carbhydrates and fat. The average daily yield of milk was 23.4 pounds.

Six days were then spent in gradually changing the above ration for one made up of *fifty pounds of green rye,* cut fresh each day, three pounds of bran and twenty-six and one-half pounds of brewers' grains. The digestibility of green rye has not been definitely settled, and, in all probability, it varied in this experiment from day to day. Approximately, this ration contained two and one-half pounds of digestible proteine and thirteen pounds of digestible carbhydrates and fat. For several days it was eaten readily, but on the 27th of May the cows showed a decided dislike for the rye. Each succeeding day the quantity wasted increased, the milk yield, meanwhile, decreasing. The rye was now evidently unfit for soiling; on May 31st the experiment was, therefore, discontinued. During the time that the rye was eaten without waste the average daily yield of milk was 24 pounds per cow, a slight increase over the yield during the first period.

During the next period 50 pounds of rye ensilage was substituted for the green rye; in all other respects the ration remained unchanged.

This ensilage had been stored in the silo nearly thirteen months, having been packed on the 6th of May, 1882. It was slightly acid, but free from disagreeable smell. From the first it was readily eaten by the cows. The daily yield of milk for this period of nine days was 23.8 pounds per cow, only two-tenths of one pound less than the average when fresh rye was fed.

These experiments lead to the following conclusions:

A good milk ration can be made by mixing young rye with sufficient nitrogenous food.

The claim, that rye at a certain stage in its growth becomes unfit for soiling, is doubtless correct.

Cut while tender and stored as ensilage, rye can be preserved for more than a year and then be substituted for green rye, pound for pound, without noticeably decreasing the yield of milk.

The above conclusions rest upon the following milk record:

Daily Yield of Milk from Ration Containing—								
TIMOTHY, HAY AND CORN MEAL.			GREEN RYE.			RYE ENSILAGE.		
Date.	Cow No. I.	Cow No. II.	Date.	Cow No. I.	Cow No. II.	Date.	Cow No. I.	Cow No. II.
May			May			June		
6	24.0 lbs.	20.0 lbs	23	24.5 lbs.	24.5 lbs	3	24.0 lbs.	23.0 lbs
7	25.0 "	20.5 "	24	24.5 "	24.0 "	4	23.5 "	24.0 "
8	25.0 "	22.5 "	25	23.0 "	25.0 "	5	25.5 "	25.0 "
9	24.0 "	22.5 "	26	24 0 "	23.0 "	6	25.0 "	25.0 "
10	25.0 "	22 5 "	27	24.0 "	23.5 "	7	24.5 "	23.5 "
11	25.5 "	23.0 "	28	23.0 "	21.5 "	8	24.0 "	23.5 "
12	25.0 "	22.5 "	29	22.0 "	22.5 "	9	22.5 "	23.5 "
13	24.5 "	22.0 "	30	22.0 "	22.0 "	10	23.0 "	23 0 "
14	25.0 "	21.5 "				11	23.5 "	23.0 "
Av'ge,	24.8 lbs.	21.9 lbs				Av'r'ge,	23.9 lbs.	23.7 lbs.
Herd average......		23.4 lbs	Herd average for first 5 days......		24 lbs.	Herd average........		23.8 lbs.

No differences in taste, general appearance, &c., were noticed in the milk from the various rations. Differences in chemical composition may have existed, however. Unfortunately analyses were not made; fertilizer samples fully occupying the laboratory force at that time.

About the middle of last June, a quantity of tough rye was stored away, in order to learn whether its condition could be improved by changing it into ensilage. This silo has not yet been opened.

MILK.

TRIALS OF THE TOTAL PERCENTAGE OF SOLIDS IN MILK.

Monthly trials have been made of the percentage of total solids in milk from each of twelve dairies. These have been continued through the whole year, and the results represent the average for 230 cows. The herds average 19 each, the largest containing 36 and the smallest 7. In all, 140 trials have been made, and the average of all for the whole year is 12.99 per cent. of total solids. The highest percentage found was 15.47, and the lowest was 11.67. Of the 140 samples 6 have fallen below the lawful standard of 12 per cent., though at most only to one-third of one per cent.

The details of size of herds, times of taking samples, percentages of solids at each trial, the averages for each herd for each month, and for the whole year, are given in the tables following. And the food provided for the different herds each month is also given in tabular form.

The authenticity of the samples is given in the following letter from Hon. I. W. Nicholson, of Camden:

"CAMDEN, N. J., Jan. 19th, 1884.

"*Prof. Geo. H. Cook:*

"DEAR SIR—Yours received yesterday, and I take pleasure in replying to your questions. The samples of milk sent you were collected by R. Levis Shivers and myself, and the most were taken when both of us were together; the dairies selected were in the best grazing part of the county, and the owners of them are what are known as 'dairy farmers,' that is, their milk is sent to the cities and sold there. The milk was thoroughly stirred and a proportionate quantity taken from each can or vessel containing it, and the sample taken from it put in a pint bottle, closely corked, with the number of the cows then being milked in the dairy, and the kind of feed given them at the time, placed upon each bottle; the samples were then nailed up in a box and sent by express to New Brunswick. These samples were mostly taken from the evening's milk.

"I am sorry I did not note the quantity of milk given by each dairy at the time of taking the samples. Take No. 4, for instance: May 1st, the per cent. of solids was 12.08, and October 23d, when the cows were giving but a short quantity, it contained 15.47, which was the highest of any of the analyses; the following month, by the addition of a few fresh cows to the herd, the per cent. of solids was reduced nearly 2 per cent.

"Leaving out herd No. 12, which is a registered herd, the average of the different herds is much nearer than could have been expected, I think.

"Any other information that I can give I will cheerfully do at once, if this does not include all you desire.

"Respectfully,

"I. W. Nicholson."

MILK ANALYSES—Percentage of Total Solids.

Number of Herd.		1883. Feb. 21.	1883. Mar. 20.	1883. May 1.	1883. May 22.	1883. June 19.	1883. July 31	1883. Sept. 4.	1883. Sept. 26.	1883. Oct 23.	1883. Nov. 27.	1883. Dec. 18.	1884. Jan. 16.	Average for the Year.
1	Number of Cows in Herd	40	36	32	32	36	36	42	32	36	35	40	36	36
	Total Solids in Milk	13.51	12.92	12.68	13.01	12.24	13.47	12.74	12.75	12.80	12.75	13.18	13.25	12.94
2	Number of Cows in Herd	27	28	22	21	24	24	22	24	24	26	25	27	25
	Total Solids in Milk	13.51	12.30	12.40	12.80	12.58	12.71	13.56	13.09	12.55	13.14	13.00	13 00	12.89
3	Number of Cows in Herd	12	12	10	13	14	14	14	15	14	12	15	12	13
	Total Solids in Milk	12.59	12.81	11.70	13.79	12.92	12.60	13.37	13.96	13.19	13.55	12.96	12.72	12.97
4	Number of Cows in Herd	30	30	35	32	32	32	32	30	30	35	(?) 35	36	32
	Total Solids in Milk	12.86	12.66	12.08	12.72	12.41	12.77	13.10	13.62	15.47	13.68	13.47	12.98	13.15
5	Number of Cows in Herd	34	34	40	35	35	40	45	....	37	38	37	34	37
	Total Solids in Milk	13.42	12.39	12.86	12.75	12.48	12.53	12.66	....	12.11	12.87	13.06	12.91	12.78
6	Number of Cows in Herd	5	8	11	18	18	20	19	20	20	12	12	16	15
	Total Solids of Milk	12.59	11.78	12.86	12 51	12.86	13.11	14.21	13.04	13.72	13.95	13.60	13.80	13.18

MILK ANALYSES—Continued.

Number of Herd.		1883. Feb. 21.	1883. Mar. 20.	1883. May 1.	1883. May 22.	1883. June 19.	1883. July 31.	1883. Sept. 4.	1883. Sept. 26.	1883. Oct. 23.	1883. Nov. 27.	1883. Dec. 18.	1884. Jan. 16.	Average for the Year.
7	Number of Cows in Herd	4	7	9	9	9	9	9	8	7	6	7	6	7
	Total Solids in Milk	11.90	12.05	12.14	13.05	....	12.29	12.71	13.76	13.58	13.39	13.30	13.27	12.86
8	Number of Cows in Herd	10	10	14	9	16	13	15	19	13	15	14	13	14
	Total Solids in Milk	12.48	12.04	12.09	12.97	12.16	11.67	12.63	13.12	13.80	13.30	13.52	12.89	12.72
9	Number of Cows in Herd	13	13	10	13	12	12	14	13	12	14	12	12	13
	Total Solids in Milk	12.58	12.26	11.92	12.89	12.41	12.20	12.29	13.51	13.25	12.08	12.66	12.77	12.52
10	Number of Cows in Herd	12	12	12	15	16	16	16	13	....	16	12	10	13
	Total Solids in Milk	12.90	12.54	12.03	13.28	12.56	13.10	13.21	12.97	13.88	13.79	12.92	13.16	13.03
11	Number of Cows in Herd	13	14	21	22	26	26	26	27	27	22	15	....	22
	Total Solids in Milk	13.27	12.20	11.72	13.85	12.36	12.89	12.56	13.41	14.07	13.78	13.56	12.97	13.05
12	Number of Cows in Herd	22	23	19	24	26	....	26	....	24	....	....	21	23
	Total Solids in Milk	13.77	13.95	13.68	13.84	13.38	13.10	13.78	....	15.07	....	14.27	14.91	13.97
	Total Solids in Milk—Average for 12 Herds.	12.94	12.45	12.34	13.08	12.58	12.70	13.07	13.32	13.62	13.01	13.29	13.17	12.99

RATIONS FED TO COWS FROM WHICH MILK SAMPLES WERE TAKEN.

Number of Herd.	1883. Feb. 21.	March 20.	May 1.	May 22.	June 19.	July 31.	Sept. 4.	Sept. 26.	Oct. 23.	Nov. 27.	Dec. 18.	1884. Jan. 16.
1	Grains, Hay and Corn Stalks.	Grains, Bran, Hay and Corn Stalks.	Bran, Hay, C. S. Meal, Grains.	Grains and Pasture.	Grains and Pasture.	Grains and Pasture.	Fodder Corn, Pasture and Grains.	Pasture and Grains.	Pasture, Grains and Hay.	Grains, Cut Stalks, Hay and Pasture.	Hay, Corn Stalks, Bran, Grains and C. S. Meal.	Grains, Corn Stalks and Mixed Hay.
2	Grains, Corn Meal, Hay and Beets.	Grains, Corn Meal, Bran, Cake Meal, Hay and Corn Stalks.	Grains, Corn Meal, Corn Stalks and Hay.	Grains and Pasture.	Grains and Pasture.	Pasture, Fodder Corn and Grains.	Pasture and Grains.	Pasture and Grains.	Pasture, Grains and Potatoes.	Grains, Middlings, Hay, Straw and Cabbage.	Grains, Middlings, Hay, Sugar Beets and Corn Stalks.	Grains, Cob Meal, Sugar Beets, Mixed Hay and Corn Stalks.
3	Bran, Corn Meal, Hay and Corn Stalks.	Bran, Corn Meal, Hay and Corn Stalks.	Bran, Corn Meal, Hay and Corn Stalks.	Pasture.	Pasture.	Pasture.	Pasture.	Pasture, Corn Meal and Oats.	Pasture, Corn Meal and Oats.	Bran, Hay, Stalks and Cabbage.	Corn, Oats, Bran, Corn Stalks and Hay.	Corn Meal; Bran, Corn Stalks and Mixed Hay.
4	Grains, Hay, Corn Meal and Corn Stalks.	Corn Meal, Bran, Hay and Corn Stalks.	Bran, Corn Meal, Hay and Corn Stalks.	Pasture and Bran.	Pasture.	Pasture.	Pasture and Fodder Corn.	Pasture.	Bran, Pumpkins and Cabbage.	Hay, Cabbage, Bran and Pasture.	Grains, Bran, Hay and Corn Stalks.	Bran, Corn Stalks, Corn Meal and Hay.
5	Clover Hay, Ensilage, Corn Stalks, Bran and C. S. Meal.	Ensilage, Corn Stalks, Clover Hay, Grains, C. S. Meal, Flax-seed Meal.	Grains, Rye and Meadow Grass.	Green Rye and Grains.	Pasture, Clover and Grains.	Pasture, Grains and Fodder Corn.	Pasture, Fodder Corn, C S. Meal and Grains.		Pasture, Grains and Fodder Corn.	Grains, Flaxseed Meal and Ensilage.	Ensilage, C. S. Meal, Grains, Middlings, Corn Stalks.	Ensilage, Middlings, Flax Seed, Cotton Seed and Grains.
6	Corn Stalks, Corn Meal, Bran and Hay.	Corn Stalks, Bran, Corn Meal, Grains and Hay.	Grains, Corn Meal, Corn Fodder and Wheat Chaff.	Rye and Grains.	Pasture and Grains.	Pasture, Grains and Fodder Corn.	Pasture and Grains.	Pasture, Ground Wheat and Grains.	Pasture, Grains and Ground Wheat.	Grains, Bran and Pasture.	Corn Meal, Bran, Grains, Oil Cake, Corn Fod., Chaff & Cabbage.	Corn Meal, Grains, Bran, Corn Stalks, Hay and Cabbage.

RATIONS FED TO COWS—Continued.

Number of Herd.	1883. Feb. 20.	March 20.	May 1.	May 22.	June 19.	July 31.	Sept. 4.	Sept. 26.	Oct. 23.	Nov. 27.	Dec. 16.	1884. Jan. 16.
7	Grains, Hay and Corn Stalks.	Grains, Hay and Corn Stalks.	Brewers' Grains, Corn Stalks and Clover Hay.	Upland Pasture.	Pasture.	Pasture and Fodder Corn.	Pasture.	Pasture and Cabbage.	Pasture.	Bran, Corn Fodder and Hay.	Bran, Hay and Stalks.	Cob Meal, Bran, Corn Stalks and Hay.
8	Grains, Malt Dust and Corn Stalks.	Grains, Malt Dust, Hay and Corn Stalks.	Grains, Corn Stalks and Hay.	Pasture of Rye and Grass, with Grains.	Pasture.	Pasture and Grains.	Pasture and Grains.	Pasture and Grains.	Pasture and Grains.	Grains, Cabbage and Pasture.	Grains and Clover Hay.	Grains, Hay and Corn Stalks.
9	Clover Hay, Grains and Corn Stalks.	Clover Hay, Grains and Corn Stalks.	Corn Meal, Bran, Corn Stalks and Hay.	Clover Pasture.	Pasture.	Pasture	Pasture, Potatoes and Bran.	Pasture and Grains.	Pasture and Grains.	Grains, Turnips and Hay.	Corn Meal, Bran, Hay and Corn Stalks.	Grains, Corn Meal, Corn Stalks and Mixed Hay.
10	Grains, Corn Meal, Bran, Hay and Corn Stalks.	Grains, Corn Meal, Hay and Corn Stalks.	Grains, Corn Meal, Hay and Corn Stalks.	Pasture and Grains.	Pasture	Pasture, Potatoes and Grains	Pasture, Potatoes and Grains	Pasture and Grains.	Pasture and Grains.	Grains, Hay, Stalks and Cabbage.	Corn Stalks, Hay and Grains.	Grains, Corn Meal, Corn Stalks and Hay.
11	Grains, Corn Stalks, Hay and Bran.	Grains, Corn Stalks, Hay and Bran.	Grains, Corn Stalks, Hay and Bran.	Pasture and Grains.	Pasture and Grains.	Pasture, Potatoes and Grains.	Pasture and Grains.	Pasture and Grains.	Pasture and Grains.	Grains, Stalks, Hay and Cabbage.	Corn Stalks, Hay and Grains.	Grains, Bran, Corn Stalks, and Mixed Hay.
12	C. S. Meal, Corn Stalks, Bran, Oat Straw and Timothy Hay	Cob Meal, Bran, C S. Meal, Corn Stalks, Oat Straw and Timothy Hay	C. S. Meal, Bran, Corn Meal and Pasture.	Pasture, Bran, Corn Meal and C. S. Meal.	Pasture.	Pasture.	Pasture and Bran.		Pasture, Bran, C. S. Meal and Corn Meal.			Malt Sprouts, Bran, Cob Meal and Corn Stalks.

MISCELLANEOUS.

◆

YELLOW TOBACCO.

Seeds of this variety of tobacco were sent out to a number of persons cultivating lands in Southern New Jersey, but nothing encouraging has been received from them. Tobacco-growing and curing is an art which is acquired by some labor and experience, and farmers who are engaged in a regular routine of work do not like to change from it to the growing of new crops. The profits of tobacco-growing are so promising that it seems worthy of a trial, and it is to be hoped that some of our farmers will undertake it. It is not necessary to repeat what was published fully upon this subject in the report of 1883.

COTTON.

Through the favor of Prof. Jos. A. Holmes, of the University of North Carolina, we received seeds of upland cotton, which had been grown in the coolest of the cotton-growing region of that State. These seeds were sent to a large number of farmers, most of whom have reported the results of their trials. They are, however, mostly unfavorable. The season was so cool in June, July and August that the cotton was late in developing, and the frost of the first week in September put a sudden stop to its growth at a time when there was, in some cases, a promise of maturing a good crop. The plants grown were large and loaded with bolls. In ordinary seasons most of it would, no doubt, have ripened. Should persons owning land and controlling labor propose to enter into this new branch of farming, they may find it desirable to add this to their other crops.

In Cape May county, Senator W. B. Miller reports of it, that—

"Though not planted until June 6th, on average about two-thirds of the bolls matured and bursted out finely before frost. I am satisfied that we can grow cotton in Cape May successfully, if it is planted early, say in April or first of May, and as much attention paid to it as the farmers pay to their other crops. The cotton plants were very large and handsome."

In Cumberland county, Mr. Charles Hunt, of Bridgeton, reports, that—

He planted about an eighth of an acre on the 9th of May, but its germination was much retarded by drought. It grew luxuriantly. The Sea Island cotton was very large, but did not mature; the other varieties grew large and were heavily loaded with bolls, which opened with handsome cotton, and continued to open until frost came, which was when about one-third had opened. Betweeen 40 and 50 pounds of cotton were gathered, and this was only a third or fourth of what was opened, and Mr. Hunt thinks there would be no trouble in producing a large crop of good cotton.

In Atlantic county, Z. U. Matthews, Esq., of Hammonton—

Planted the seed May 11th, but it was very slow in coming up, on account of cool and dry weather. It grew well, though retarded by cool, dry weather in August. About one-half the bolls opened before the first frost. He is "perfectly satisfied that cotton can be grown here, easily and to perfection. Several persons who have seen cotton growing in the South and saw mine, called it very thrifty and fine. * * * The profit of cotton-growing in South Jersey is a question still unsolved."

In Burlington county, Emmor Roberts, of Fellowship, reports, that—

He planted the cotton seed on the 10th of May, in his garden. It grew rapidly, and by the first of September "had attained a height of from four to six feet—had an abundance of bloom and many bolls. About the 10th of September we had a severe frost, * * * nevertheless, many of the bolls bursted finely. Many were taken as curiosities, and when hung up by a string in the house, would blow out beautifully, the flossy cotton hanging from four to six inches."

In Ocean county, Dr. Theo. F. Pruden, of Toms River, reports, that—

Jas. G. Gowdy, Esq., of that place, grew cotton this year, which produced a good crop. An early frost there killed the plants before all the bolls were sufficiently matured to open.

In New Brunswick, Prof. Jacob Cooper—

Grew cotton which matured so that some bolls opened before the unseasonably early frost of September 4th nipped the plants.

The conclusion is a safe one, that good crops of cotton can be raised in all of Southern New Jersey, where circumstances show that it is profitable to do so. When a trial is to be made carefully, it will be safe to get seed grown in the coolest part of North Carolina, where cotton is grown as a crop. It can probably be found in Raleigh.

COW PEAS.

In the last year's report, mention was made of the cow pea as a leguminous crop of much interest to our farmers. It is annual, and possesses many of the most valuable properties of red clover. In all the Southern States it is cultivated for its yield of peas for food, for its vines as a forage crop, and for its rapid and abundant growth of vines and leaves to turn under as a green crop and enrich the soil. Our seasons, here at the North, are probably too short for the plants to thoroughly mature their seed, but they grow well and furnish a large supply of green fodder, which, as far as our analyses and experiments go, is equal to clover.* The past season it was grown on the College Farm, and, though sown late, it grew well and promised a good crop of fodder, but the early frost checked its growth. It was mown and fed to cows, and made an excellent green fodder.

There is good reason to believe that all that was said of it in last year's report will be verified by its cultivation in New Jersey.

PEACH TREES AND THEIR SPECIAL FERTILIZERS.

In the early settlements of New Jersey, the peach tree was very thrifty, yielding large crops of peaches of the best quality, and continuing its healthy and vigorous growth from twenty to fifty years.

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*Analyses of vines grown this year by Joseph W. Killam, of Lakewood, are given under foods and fodders.

Now the trees are subject to a disorder called the yellows, and their production to two or three good crops, and the whole life of the tree only covers from six to ten years. The crop is a large and valuable one, and it seems a fair subject for experiment by the Station to see if by proper management the trees can again be brought to their old-time vigor.

Dr. Goessman, of the Massachusetts Agricultural College, and Prof. D. P. Penhallow, of McGill College, have proposed and experimented with muriate of potash. The theory upon which Dr. Goessman acted was, that the disease of the trees was owing to an unnatural growth and accumulation of starch in the pores of the trunks and branches of the trees, so as to retard and almost stop the circulation of the sap; and that potash manures, especially muriate of potash, would both tend to dissolve out the starch in these clogged vessels, and would promote the rapid and healthy growth of the trees. Both these gentlemen have tried the experiment and report that it is successful; that trees far gone with the disorder have changed their yellow leaves for green ones, and put out coarse and rank suckers and twigs in place of the thin and unnatural ones which were so prominent a mark of the diseased trees.

The beneficial effect of wood ashes, which contain much potash, upon the growth of trees, is well known to all farmers. In our experiments with different fertilizers upon the growth of corn and corn stalks, which have now been conducted for twelve consecutive years, muriate of potash has always been found to produce a marked effect on the weight of the stalks, they being uniformly heavier. A fruit grower in this neighborhood has been in the practice of washing and fertilizing his peach trees with potash for several years, and has succeeded in getting good crops of fruit, and in keeping his trees in full vigor for some years beyond the time at which such trees usually die. We also recommended the use of muriate of potash to several growers of peach trees in the spring of 1883, and have much satisfaction in learning just now from two of them, that their trials with it proved entirely successful as far as one year's experience will go.

These considerations encourage us to recommend further trials with this salt of potash as a special manure for peach trees. It can be scattered directly upon the surface of the ground around the tree, keeping it a foot or so away from the trunk and extending it out as far as the branches reach. From two to five pounds per tree, according to its size, may be applied, and the fertility of the soil would be improved if an equal quantity of plain superphosphate from bone black or South Carolina rock, were also applied.

FIELD EXPERIMENTS WITH FERTILIZERS ON SWEET-POTATOES.

By Josiah Budd, Jr., Woodbury, Gloucester Co., N. J.

	FERTILIZERS.			YIELD PER ACRE.		
Number of Plot.	Kind.	Weight per Acre.	Cost per Acre.	Number of Bushels Good.	Number of Bushels Poor.	Total Yield.
1	Nitrate of Soda	360 lbs.	$10.80	45.0	45.0	90.0
2	Superphosphate	350 "	5.25	82.7	82.7	165.4
3	Muriate of Potash	360 "	9.75	105.2	45.0	150.2
4	Nitrate of Soda Superphosphate	150 350 "	9.75	77.0	58.2	135.2
5	Nitrate of Soda Muriate of Potash	159 159 "	8.20	80.0	53.0	133.0
6	Superphosphate Muriate of Potash	350 150 "	8.50	82.6	58.2	140.8
7	Nitrate of Soda Superphosphate Muriate of Potash	150 350 " 150	13.00	59.0	45.2	104.2
8	Plaster	2,400 "	9.00	77.0	58.0	135.0

Sweet-potatoes are usually grown in light, sandy soils of low fertility, and fertilizers are always used in growing them. A compost made largely from animal manures and applied in the hills, is generally used. Where such manure runs short, chemical fertilizers have been substituted with a fair degree of success. Muriate of potash has been most generally approved for this use. There is a common belief that quicklime, or lime as used upon ordinary crops, is injurious to sweet-potatoes. The experiments of Mr. Budd were made by adding the fertilizers above named to his compost. The ground had been badly diseased when last cultivated in sweet-potatoes, and it evidently has not yet recovered.

The crop was much better than Mr. Budd anticipated, from the appearance of the vines before digging, and the difference in amount and quality is so considerable as to encourage hope of arresting or diminishing this disease, and of warranting farther and somewhat varied experiments with the same fertilizers. Plans for continuing the experiments another season are already prepared, and it is to be hoped that their success may be such as to enable us to draw some conclusions which will be of use to farmers.

APPENDIX.

ACT OF INCORPORATION.

The New Jersey Agricultural Experiment Station was established by authority of the following acts of the Legislature of the State:

CHAPTER CVI.

AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF AN AGRICULTURAL EXPERIMENT STATION.

1. Be it enacted *by the Senate and General Assembly of the State of New Jersey,* That for the benefit of practical and scientific agriculture, and for the development of our unimproved lands, the New Jersey Agricultural Experiment Station, with suitable branches, is hereby established.

2. *And be it enacted,* That the direction and management of this institution shall be committed to a Board of Directors, which shall consist of the Governor of the State, the Board of Visitors of the State Agricultural College, together with the President and the Professor of Agriculture of that institution.

3. *And be it enacted,* That the members of this Board shall be called together by the Secretary of the Board of Visitors, and shall organize by the election of a president and secretary, who shall hold their offices for one year, and until their successors are elected; five members shall constitute a quorum.

4. *And be it enacted,* That the Board of Directors shall hold a meeting each year, at Trenton, on the third Tuesday in January, and other meetings at the call of the President, at such times and places as may best promote the objects of the institution.

5. *And be it enacted,* That the Board of Directors shall locate said

Experiment Station and branches, and shall appoint a Director, who shall have the general management and oversight of the experiments and investigations necessary to carry out the objects of said institution, and shall employ competent chemists, and other assistants necessary to analyze soils, fertilizers and objects of agricultural interest, so as to properly carry on the work of the Station, and it shall make an annual report of its work to the Governor of the State.

6. *And be it enacted*, That a sum not exceeding five thousand dollars in any one year, is hereby appropriated to said New Jersey Experiment Station, which money shall be paid out from the State Treasury on the presentation of the bills of said Station, properly certified by the President and Secretary of the Board of Directors.

7. *And be it enacted*, That this act shall take effect immediately.

Approved March 10th, 1880.

CHAPTER LXXXI.

A SUPPLEMENT TO THE ACT ENTITLED "AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF AN AGRICULTURAL EXPERIMENT STATION," APPROVED MARCH TENTH, ONE THOUSAND EIGHT HUNDRED AND EIGHTY.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey*, That from and after the passage of this act, the Board of Directors, mentioned and created by said act, shall be called and known as the Board of Managers.

2. *And be it enacted*, That in addition to the powers now conferred upon said Board, they shall have power to elect a Treasurer, who shall hold his office for one year, and until his successor shall be elected and qualified; and to appoint such other officers and agents as may be necessary to carry on the business of the institution; and to make such rules, by-laws and regulations for the government of the Board, and for carrying out the objects, business and purposes of the institution, as may, in their judgment, be necessary and proper.

3. *And be it enacted*, That the annual appropriation for the support of the New Jersey Agricultural Experiment Station be and the same is hereby increased from its present sum of five thousand dollars a year to eight thousand dollars a year.

4. *And be it enacted*, That this act shall take effect immediately.

Approved March 9th, 1881.

LAWS OF NEW JERSEY.

AN ACT TO REGULATE THE MANUFACTURE AND SALE OF FERTILIZERS.

1. That every commercial fertilizer which shall be offered for sale in this State shall be accompanied by an analysis, stating the percentage therein of ammonia, or its equivalent of nitrogen; of potash, in any form or combination, soluble in distilled water; and of phosphoric acid in any form or combination; the portion of phosphoric acid soluble in distilled water; that portion soluble in a neutral solution of citrate of ammonia at a temperature not exceeding one hundred degrees Fahrenheit; and that portion of phosphoric acid not soluble in either of the above named fluids, shall each be determined separately; and the material from which the phosphoric acid is obtained shall also be stated; a legible statement of such analysis shall accompany all packages or lots of over one hundred pounds, sold, offered or exposed for sale.

2. That the Chemist of the State Board of Agriculture shall be the Inspector of Fertilizers; it shall be his duty to analyze one or more samples of every kind of commercial fertilizers coming within the provisions of this act, which may be offered for sale within this State, and of which he shall be informed.

3. That manufacturers, dealers, and all persons interested, may obtain an analysis by notifying the Chemist of the State Board of Agriculture, upon which notification he shall be authorized to analyze, at his discretion, samples selected by himself, and to furnish certified copies of such analyses to the persons on whose application they were made; and it shall also be his duty to report all such analyses to the State Board of Agriculture.

4. That the Chemist of the State Board of Agriculture shall receive for each certificate of analysis made by him, a sum not to exceed fifteen dollars, to be paid by the person or persons applying therefor.

5. That any person selling, offering or exposing for sale any commercial fertilizer without the analysis required by the first section of this act, or with an analysis stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense, and one hundred dollars for each subsequent offense.

Approved March 24th, 1874.

SUPPLEMENT.

6. Sec. 1. That the penalty or penalties prescribed in section five of that act may be sued for and recovered, in an action of debt, in any court of competent jurisdiction in this State, in the name of any person who will sue for the same, one-half thereof for his own use, and the other half to be paid to the county superintendent of public schools of the county in which such suit or suits shall be brought, for the use of the public schools in their county.

Approved March 31st, 1875.

A SUPPLEMENT TO AN ACT ENTITLED "AN ACT TO REGULATE THE MANUFACTURE AND SALE OF FERTILIZERS," APPROVED MARCH TWENTY-FOURTH, ONE THOUSAND EIGHT HUNDRED AND SEVENTY-FOUR.

1. Be it enacted *by the Senate and General Assembly of the State of New Jersey,* That the fifth section of the act to which this act is a supplement, which section now reads as follows:

"5. *And be it enacted,* That any person selling, offering or exposing for sale any commercial fertilizer without an analysis required by the first section of this act, or with an analysis stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense," be and the same is hereby amended so as to read as follows:

5. *And be it enacted,* That any person selling, offering or exposing for sale any commercial fertilizer without any analysis required by the first section of this act, or the act to which this act is a supplement, or with an analysis stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense; *provided further,* that the provisions of this section, or the act to which this act is a supplement, shall not apply to any manure sold at a price not exceeding one-half a cent per pound, nor to any imported guanos.

2. *And be it enacted,* That this act shall take effect immediately.

Approved March 27th, 1878.

INSTRUCTIONS

FOR SAMPLING COMMERCIAL FERTILIZERS FOR THE NEW JERSEY AGRICULTURAL EXPERIMENT STATION.·

The *commercial value* of a high-priced fertilizer can be estimated, if the percentages of its principal fertilizing elements are known. Chemical analysis of a small sample, so taken as to fairly represent a large lot, will show the composition of the lot. The accompanying instructions, if faithfully followed, will insure a fair sample. Special care should be observed that the sample neither gains nor loses *moisture* during the sampling or sending, as may easily happen in extremes of weather, or from even a short exposure to sun and wind, or from keeping in a poorly-closed vessel. It is most satisfactory to take samples from the lots bought by farmers for their own use, and, where it can conveniently be done, the Station will send an agent to take out the samples, if notice is given.

First.—Provide a tea cup, some large papers, and for each sample a glass fruit jar holding about one quart, that can be tightly closed, all to be clean and dry.

Second.—Weigh separately at least three (3) average packages (barrels or bags) of the fertilizer, and enter these *actual weights* in the "Form for Description of Sample."

Third.—Open the packages that have been weighed and mix well together the contents of each, down to one-half its depth, emptying out upon a clean floor if needful, and crushing any soft, moist lumps, in order to facilitate mixture, but leaving unbroken, hard, dry lumps, so that the sample shall exhibit the texture and mechanical condition of the fertilizer.

Fourth.—Take out five (5) equal cupfuls from different parts of the mixed portions of each package. Pour them (15 in all) one over another upon a paper, intermix again thoroughly but quickly to avoid loss or gain of moisture, fill a can or box from this mixture, close tightly, *label plainly*, and send, charges prepaid, to

THE NEW JERSEY AGRICULTURAL EXPERIMENT STATION,
New Brunswick, N. J.

FORM FOR DESCRIPTION OF SAMPLE FOR ANALYSIS.

The person sending samples to the Station for analysis without charge, will be provided with a form like this for each sample, and must fill up every one of the blank particulars given, so as to make the description complete and definite, and in every case write his signature, as endorsing the accuracy of it. As there is much responsibility in taking fair average samples, such as will justly represent the manufacturer as well as the consumer, it is very important that every precaution be taken, so that in case of a suit at law the person signing the description can testify to its accuracy. The writing should be plain and legible. The filled-out form, if wrapped with the sample, will serve as a label. If any printed circular, pamphlet, analysis or statement accompanies the fertilizer, or is used in its sale, send a copy with the specimen.

1. *Brand of Fertilizer*..

2. *Name and address of Manufacturer*..

....

3. *Name and address of Dealer from whose stock this sample is taken*,

....

4. *Date of taking this sample*..

5. *Selling price per ton, hundred, bag or barrel*..........................

6. *Selling weight claimed for each package weighed*.....................

7. *Actual weights of packages opened*...

8. *Copy of analysis or guaranteed composition affixed to packages of this Fertilizer*..

9. *Signature of person taking sample*...

Name..

P. O. Address...

ORDER OF STATION WORK.

The largest portion of the Station work is in the Analysis of Fertilizers, Field Experiments, Feeding Experiments, with Analyses of Foods, Fodders, Milk, &c. To do these branches of work well, continuous and steady attention must be given to each of them while it is in progress, and other business has to be laid aside for the time. To make this necessary order of work as little disappointing as possible for those who desire work at the Station, we publish this statement of the subjects upon which we propose to work at the different periods of the year:

Feeding Experiments	January and February.
Analyses of Fertilizers	March to September 15th.
Field Experiments	April and May.
Field Experiments	Sept. 15th to Nov. 30th.
Annual Report	December.

Miscellaneous work of various kinds may arise to interfere with the perfect regularity of this plan, but for accomplishing the largest amount of work it will be necessary to adhere as closely to it as possible.

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FIFTH ANNUAL REPORT

OF THE

NEW JERSEY STATE

AGRICULTURAL EXPERIMENT STATION,

FOR THE YEAR

1884.

THE PRINCETON PRESS:
C. S. ROBINSON & CO., PRINCETON, N. J.
1884.

To His Excellency Leon Abbett, Governor of the State of New Jersey:

SIR—I have the honor to submit herewith the fifth annual report of the New Jersey State Agricultural Experiment Station, as required by the law establishing the Station, which was approved March 10th, 1880, and which is chapter CVI. of the laws of that year.

WILLIAM S. TAYLOR,
President.

NEW BRUNSWICK, N. J., December 31st, 1884.

BOARD OF MANAGERS.

His Excellency LEON ABBETT, Trenton,
Governor of the State of New Jersey.

MERRILL E. GATES, Ph.D., LL.D., New Brunswick,
President of the State Agricultural College.

GEORGE H. COOK, LL.D., New Brunswick,
Prof. of Agriculture of State Agricultural College.

	Residences.	*Terms Expire.*
FIRST CONGRESSIONAL DISTRICT.		
DAVID A. SHREVE, Esq.,	Haddonfield,	April 18, 1886.
I. M. SMALLEY, Esq.,	Roadstown,	April 18, 1886.
SECOND CONGRESSIONAL DISTRICT.		
Hon. WILLIAM PARRY,	Parry,	March 8, 1885.
WILLIAM S. TAYLOR, Esq.,	Burlington,	April 18, 1886.
THIRD CONGRESSIONAL DISTRICT.		
JOHN V. N. WILLIS, Esq.,	Marlboro,	April 18, 1886.
JAMES NEILSON, Esq.,	New Brunswick,	April 18, 1886.
FOURTH CONGRESSIONAL DISTRICT.		
JOHN DeMOTT, Esq.,	Middlebush,	April 12, 1885.
CALEB WYCKOFF, Esq.,	Belvidere,	April 22, 1886.
FIFTH CONGRESSIONAL DISTRICT.		
HENRY P. SIMMONS, Esq.,	Passaic,	April 18, 1886.
*CORNELIUS A. WORTENDYKE, Esq.,	Wortendyke,	April 12, 1885.
SIXTH CONGRESSIONAL DISTRICT.		
Hon. GEORGE H. HARTFORD, Esq.,	Orange,	April 18, 1886.
WILLIAM M. FORCE, Esq.,	Newark,	March 8, 1885.
SEVENTH CONGRESSIONAL DISTRICT.		
ABRAHAM W. DURYEE, Esq.,	New Durham,	April 18, 1886.
JAMES STEVENS, Esq.,	Jersey City,	April 18, 1886.

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*Deceased.

OFFICERS OF THE BOARD.

WILLIAM S. TAYLOR, Esq.,	President.
ABRAHAM W. DURYEE, Esq.,	Vice President.
JAMES NEILSON, Esq.,	Treasurer.
JOHN DeMOTT, Esq.,	Secretary.

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GEORGE H. COOK, New Brunswick,	Director.
ARTHUR T. NEALE, New Brunswick,	Chemist.
EDWARD B. VOORHEES, New Brunswick,	First Assistant Chemist.
JOSEPH L. HILLS, New Brunswick,	Second Assistant Chemist.
IRVING S. UPSON, New Brunswick,	Clerk.
DAVID L. SCUDDER, New Brunswick,	Laboratory Attendant.

TREASURER'S REPORT.

James Neilson, in account with the New Jersey State Agricultural Experiment Station, January 1st, 1884, to January 1st, 1885.

RECEIPTS.

From State Treasurer	**$10,072 51**

PAYMENTS.

Salaries and pay of chemists and assistants	**$6,668 89**
Expenses of the Board of Managers	**106 38**
Stationery, printing and postage	**1,066 22**
Incidentals, (including telephone service)	**261 46**
Fuel, gas and stoves	**128 15**
Laboratory expenses	**847 80**
Field and feeding experiments	**810 50**
Freight, and traveling expenses in collecting samples of fertilizers	**45 91**
Camden Branch Station (not including salary of attendant)	**142 20**
	$10,072 51

Respectfully submitted,

JAMES NEILSON,

Treasurer.

The Auditing Committee of the Experiment Station have examined the accounts of the Treasurer of said Station and find them correct.

JOHN DE MOTT.
JAMES STEVENS.

REPORT.

The Fifth Annual report of the New Jersey Agricultural Experiment Station, is herewith presented. The work of the year which is here given in detail, shows that it is carrying out the objects set forth in the law under which it is organized, viz: "For the benefit of practical and scientific agriculture, and for the development of our unimproved lands."

The subjects for investigation which are brought to the Station are very numerous, far too many for us to give study to them all. We are obliged to take from them those in which the largest number of farmers are interested, those which are of the most immediate importance, or those which afford the largest opportunities to apply scientific principles in economizing labor or increasing production.

The first duty of the Station undoubtedly is, to aid farmers by the application of known scientific principles to agricultural practice. The application of chemical science to the analysis of fertilizers, feeds, fodders and soils, comes under this head and is the one most urgently called for. In this department of work where chemical skill aided by the appliances of a well furnished laboratory are necessary, the Station must do a great deal in ascertaining and furnishing information to working farmers. As chemical terms become more generally understood, and its principles appreciated, this branch of work may become lighter. But at present as it meets the immediate and expressed wants of the successful agriculturists, it must have a large share of attention.

New Jersey has been settled more than two hundred years, and during most of that period the system of farming pursued has been an exhaustive one, taking off crops from the soil and returning nothing to it,—until the soil became so poor, that the most thorough tillage and the most prudent management could not draw profitable returns from it. The discovery of the beneficial effects of commercial fertilizers is working a change in the practice as well as in the profits of farming. Without increasing the area of land tilled, or the labor of tillage, the products can be largely increased by the use of fertilizers. This proposition, simple as it is, has taken years to be fully accepted by many farmers. It is the subject which of all others is new to them; and they naturally ask for information upon the properties, the quality, and the genuineness of the fertilizers which are offered. To answer these inquiries is a large part of the work of the experiment station.

During the year just passed there have been purchased by the farmers of the State, 46,664 tons of high-priced commercial fertilizers, worth in the aggregate, $1,369,000.

There have been brought to the Station laboratory for analysis during the year, 185 samples, nearly all of different brands, made by different manufacturers. The analyses and valuations of these will be found in the following pages of this report.

It is intended to make these analyses and valuations so that they shall be worthy the confidence of the farmer, at the same time that they are just to the manufacturers. The methods of making the analyses are uniform, they are all made in duplicate, and should any discrepancy be found, the work is again repeated until equal results are obtained. In this way fair comparisons between different fertilizers can be made, even if the method should be questioned. The valuations are made from prices established at the beginning of the year, and these are continued without change through the whole season. With the fluctuations in the market prices of stock needed in compounding fertilizers, there may be changes made in the selling prices of the fertilizers themselves. If such changes do occur, our valuations may be thought unfair; but it must be considered that it is equally unfair for all, and our valuations then would not agree with the changed market price, but they are still useful in establishing the comparative values of different brands of fertilizers offered in market.

There has been great uniformity in the composition of the complete fertilizers sold by different manufacturers, and there is evidently an effort on their part to make their goods of uniform quality and fully up to their guarantees. An examination of the published tables farther on, will show how closely their work comes to their standard.

The composition and prices of simple fertilizers, such as can be used for stock in compounding fertilizers, is also given at some length. This part of our work will necessarily increase as farmers learn to know the wants of their soils, and also learn how to economize by purchasing only those constituents of a complete fertilizer, which their intended crops may need. There can be a great saving effected by intelligent farmers buying in this way, as can easily be seen by comparing the prices of these, with the prices of the same elements in mixed goods.

When mixed goods, or complete fertilizers are desired, it is doubtful whether the farmer can make them profitably. The manufacturers have the benefits of working on large quantities, of buying stock at the lowest market prices, and of using the best of labor-saving machinery. Their products, too, are usually in the very best mechanical condition.

There is some difference of opinion among farmers in different parts of our country, as to the agricultural value of super-phosphates made from bones—or from South Carolina rock, or from Canadian apatite. The discussion in regard to this is likely to continue, as the increasing demand for fertilizers must naturally bring more and more of the mineral phosphates into use. It would scarcely admit of question, that soluble phosphoric acid from one source is as good as that from any other, and the same may be said in regard to reverted phosphoric acid. But of the insoluble phosphoric acid it is claimed by the manufacturers from bone, that the insoluble in their product is, on account of its cellular structure, of considerable value, while that from South Carolina Rock or from Canadian Apatite, is solid, strong, and harder than marble, and of no agricultural value. On the other hand, the manufacturers who use these latter, claim much for them, and are advocating changes in methods of analysis, so as to put their product on better grounds in the comparison. The matter is being thoroughly examined and discussed by the agricultural chemists, and we are awaiting their conclusions.

The use of commercial fertilizers is so common, and the labor attending their use is so slight, that many persons are using them exclusively for the production of both farm and market garden crops.. One successful market gardener who has been visited, says that he has not purchased any stable manure in seven years, but has depended entirely on commercial manures, which he has used liberally, and his crops have been larger and of better quality than ever before. From many others in different directions and using different brands of special or complete manures, equally positive statements have been received as to their supplying all that crops need for their healthy and luxuriant growth. These statements are interesting as confirmations of the position taken in the analysis of fertilizers, that nitrogen, phosphoric acid and potash, are the only expensive constituents in fertilizing compounds. But it is not likely that farmers will generally abandon tbe use of barnyard manures. There is nothing better or cheaper, and the proper place for commercial fertilizers is in supplementing the barnyard manures of the farm, of which latter there is never as much as is needed.

Another important duty of the Station is to conduct its experiments in feeding animals, in growing crops, or in applying fertilizers so as to reach conclusions of unquestioned accuracy. There are thousands of experiments recorded from which no reliable conclusions can be drawn for the reason that some important particulars of observation, weighing or measuring, have not been attended to or not recorded. Most of such experiments can only be considered as tentative. They may have helped by preparing the way for carefully planned, and faithfully executed experiments. And even with these there may be need for many repetitions before reliable conclusions can be drawn. Damages from the weather, from the lack of necessary skill, and from slight errors or accidents, may interfere with the first results, and it is only when honest and full records are kept, when blunders and unexpected results are acknowledged, and the work persevered in and repeated till the sources of error are eliminated, that we can expect conclusions upon which dependence can be placed. Such experiments are tedious and expensive, but they will finally bring the answers sought, and experiment stations may well take the lead in these, but similar experiments made by intelligent and skilled farmers will aid in bringing reliable conclusions.

The experiments on the growth of sorghum upon the Agricultural College farm in New Brunswick, and the study of the growing of sorghum and manufacture of sugar at Rio Grande in Cape May county, have been continued during the past year. The presentation and discussion of the results of the Station work upon this subject are given in the following pages. The conclusions reached are very interesting, and it is believed fully justify the action of the State in fostering the sugar industry, as well as in authorizing investigations to be made and published in regard to it.

The sugar market has been overstocked during the year, and prices have been unprecedentedly low. But the experiments of the season warrant the conclusion that both sugar and molasses can be successfully made in our State at the present prices. To do this will require the exercise of skill and economy—labor must be judiciously expended, the whole of the sugar must be extracted, and all by-products must be utilized.

Our soils prove to be admirably adapted to the growth of sorghum, and the extension of this great industry may find fields for its best prosecution in the hitherto unsettled lands of Southern New Jersey. In the counties of Cape May, Cumberland, Atlantic, Gloucester, Camden, Burlington, Ocean and Monmouth, there are fully 640,000 acres, or 1,000 square miles of uncleared lands which are capable of improvement, and which are well adapted to the growth of this staple crop. Vineland, Hammonton, Egg Harbor City, and many smaller settlements have been begun on these new lands within the last 25 years, and the success which has attended them is the best witness to the capabilities of the South Jersey soils.

This part of New Jersey has a truly *temperate* climate, free from the rigors of a northern winter and the enervating heats of a southern summer. The following tabular statement gives the mean temperatures of the four seasons at several well-known places:

PLACES.	YEARS.	SPRING.	SUMMER..	AUTUMN.	WINTER.	AVERAGE for the YEARS.
Cape May,.	8½	48½	72	57	35½	53.66
Greenwich, ...	9	51	73	55	33	53.12
Atco, ...	9	50	73	53	32	52.35
Vineland, ...	14	50	75	54	35	53.13

The annual rain-fall is pretty uniformly distributed through the several seasons of the year. The following is a tabular statement of the amount at each of the above places:

PLACES.	YEARS.	SPRING.	SUMMER.	AUTUMN.	WINTER.	YEAR.
Cape May, ...	9	11.36	14.01	11.39	11.41	48.17
Greenwich, . . .	9	11.53	10.27	10.26	9.47	41.53
Atco, ...	9	10.22	14.48	11.54	10.11	46.35
Vineland, ...	15	11.88	14.03	11.88	11.35	49.14

It is a salubrious climate, and has been noted by its entire freedom from malarial influences. It is specially liked by those who suffer from asthmatic and pulmonary diseases; and many come here for the relief they obtain from such ailments. The sea-side resorts are continually increasing in number and enlarging in size; and throngs of visitors come to enjoy the delightful air.

The water of this country is pure and soft. It is drained by many large rivers which are chiefly remarkable for their full and equable flow being very little affected by storms or by drouths. They furnish excellent water power for manufacturers' purposes. Those at Mays Landing, Weymouth, Batsto, Atsion, Millville, Lakewood, Manchester and Toms River, are of this kind, and there are a great many other good ones.

The soil is light but easily cultivated, and when well managed is productive. The improved lands at Vineland, Hammonton, and Egg Harbor City, are yielding large crops of market and garden products and of fruits. The staple productions are wheat, rye, oats, Indian corn, hay, potatoes and sweet potatoes, Melons are raised in abundance. Apples, pears, peaches, grapes, blackberries, raspberries, strawberries and currants, grow remarkably well.

The means of communication are good. There is an abundance of gravel for road making, and the benefits of good roads are highly appreciated. Cumberland county claims to have more good roads than any other county in the State. The West Jersey and its branches, the Glassboro' and Millville, the Millville and Cape May, the New Jersey Southern, the Camden and Atlantic, the Philadelphia and Atlantic City, the Mays Landing branch, the Pemberton and Manchester, the Tuckerton, the Toms River branch, the Toms River and Waretown, and the Freehold and Squankum branch to Squan, are all railroads in this district, and every point in it is within an easy drive of railway communication, and, by this, is within three or four hours ride of the largest and best markets on the continent.

The successful growing of sorghum on these soils has been proved at Cape May, at Bridgeton, and Vineland, and in a smaller way in numerous other places. In Cape May where the large sugar mill is established, the effect on the price of land is very marked. Lands which were unsaleable even at very low prices, have doubled and even trebled in price; in place of his former inability to sell, the farmer now shows an unwillingness to dispose of his lands even at the advanced prices.

These lands are the most northerly of the peculiar coast-lands of the Eastern United States. Under an exhaustive system of agriculture they have been undervalued—but with an improved system they are destined to become our most desirable and productive lands.

The investigations upon the growth and preparation of ensilaged crops, involves a vast amount of work, and the questions which they open will require much time and study to answer satisfactorily. There is no question but that the preservation of green fodders in silos, adds largely to the capabilities of a farm for keeping stock,—but it is questionable whether there is any more digestible food produced on an acre of ground cultivated in an ensilage crop—for example fodder-corn—than there is upon an acre of ground, in the same condition, cultivated in common field corn. To make the comparison between the two, in addition to the corn, the cornstalks after husking, must be prepared so as to be utilized for their full feeding value. Experiments in this line are detailed in the pages of this report, and thus far the advantages of one over the other are very slight, and may easily be changed by other conditions of labor and conveniences of time and location. But it does demonstrate the feeding value of the corn stalks which have been so generally wasted by farmers.

This general subject has been attacked in various directions, which are detailed in the report, but there are so many conditions of crops, time, temperature, air, &c., to be noticed before the questions of economy can have place, we cannot give any important conclusions.

Investigations having for their object the discovery of new truth, or for new methods of applying science to agriculture, are a very important part of the Station's work. From their nature they are uncertain in their results,—they cannot be concluded within any fixed time, neither can the greater part of them be successful. Still they are necessary for any Station which aims to make progress and to keep up with the advance and the demands of Scientific Agriculture. Such investigations are kept in view, by this Station, and desirable knowledge is sought for in this the legitimate way, and their results will be made public as its contribution to the common stock of science.

To bring the work done at the Station to the knowledge of farmers, at the earliest possible time, is probably its most immediately useful office. The publication of the composition and valuation of fertilizers, stimulates manufacturers, dealers and consumers to their best efforts,—and the study of the composition and cost of different fertilizers is educating our farmers so that every year is showing an advance in knowledge, and in the numbers who find their interest in it.

There is no part of the Station work which has given more satisfaction to its friends than the distribution of the Bulletins and Reports among farmers. They have been received with hearty commendation, the matters in them have been accepted and acted on, and their influence is plainly seen in the increased intelligence and mental activity of the farmers, and in the greater regard which is paid to their requirements by those who furnish their supplies.

As the prices of commercial fertilizers are based upon the quantities of nitrogen, phosphoric acid and potash which they contain, and their analyses made at the Station are relied upon by farmers, much responsibility is thrown upon our chemists, and upon those taking the samples. The former of these we accept willingly, but in regard to the latter we have felt it to be necessary to exercise increasing caution. It is a liberty, which only the special circumstances of the case can justify, to take the goods of any man and put a valuation on them. It is for the public good that it is done, and the samples need to be taken so as to be a fair average of the whole, in composition, dryness, and fineness,—so as to fairly represent the goods of the manufacturer and dealer. To ensure the taking of fair samples, we have had several sampling tubes prepared, with which samples can be taken from the middle and throughout the whole length of a bag or barrel. Most of the samples analyzed during the past year, have been collected by several disinterested and representative farmers who have favored us by taking these sampling tubes and following the instructions which are given, in full, in the appendix to this report, and sending in the samples. We have great confidence in the accuracy of sampling done in this way, and trust that it will be approved by both buyers and sellers.

LECTURE BY DR. J. H. GILBERT.—The Station has been honored this year by a visit from the eminent Dr. J. H. Gilbert, Professor of Rural Economy in the University of Oxford, England, and the associate of Sir John Bennett Lawes, in the experiments on Chemistry and Agriculture, at Sir John's residence, Rothamsted, Harpenden, St. Albans, England.

The Agricultural College, the State Board of Agriculture, the State Agricultural Society, representatives from the Connecticut Agricultural Experiment Station, the Houghton Farm, and several Farmers' Clubs, joined the Station in doing honor to this veteran in the cause of agricultural science. He lectured in the chapel of Rutgers College, on the 27th of October, to an audience which had gathered from all parts of the State to hear him.

The subject matter of his lecture was "to illustrate the value of *long continued* and *carefully conducted* experiments in reference to the results of one series of experiments conducted at Rothamsted, mainly those on the growth of wheat for more than forty years in succession, on the same land, *without manure*, *with farm-yard manure*, and with a *great variety of chemical manures*."

In his introduction he stated that their labors for the furtherance of agricultural progress, had now extended over a period of more than forty-one years; that their object was to investigate the principles underlying fundamental practices; and that their general plan in their field experiments was to grow some of the most important crops of rotation, each separately, year after year, for many years in succession on the same land, without manure, with farm yard manure, and with a great variety of chemical manures, the same description of manure being, as a rule, applied year after year on the same plot. The expense of these field experiments, independently of all chemical investigations, connected with them, is considerably more than $5,000 a year.

He alluded to their extensive laboratory arrangements; and to their drain-gauges for collecting the water which drains from the cultivated soil and carries off its fertilizing elements. He also spoke of their extensive series of experiments on the feeding of animals.

1. *Experiments on wheat without manure.*—After a five course rotation since manuring, the first crop was gathered in 1844, the highest yield of the series being 23 bushels and 1 peck, in 1845, and the lowest, 4 bushels and 3 pecks in 1879; also 21 bushels and 4 quarts in 1854; 20 bushels in 1857: 5 bushels and 28 quarts in 1853; and from 8 to 9 bushels in '67, '75, '76, and '77. With such variations it is difficult to estimate the rate of decline. Excluding very bad seasons, the decline is reckoned at between 10 and 11 quarts per acre per year. The average for the last 4 years is 12½ bushels; and that for the 40 years is 14 bushels.

2. *Experiments with farm-yard manure;* fourteen tons every year. In the application of farm-yard manure, every constituent is supplied in excess, the highest yields of the series being 44 bushels in 1863; 41 bushels and 3 pecks in 1868; 41 bushels and 1 peck in 1856; 41 bushels and 4 quarts in 1854; and the lowest being 16 bushels in 1879; 19 bushels and 4 quarts in 1853; 20½ bushels in 1844, and 23 and 24 bushels in '76 and '77. The average for the 40 years is 32 bushels and 12 quarts.

3. *Experiments with a great variety of chemical manures.*—In these experiments the superphosphate of lime, and the sulphates of potash, soda, and magnesia, are called mineral manures, while ammonium salts and nitrate of soda are spoken of as nitrogen.

With mixed mineral manures alone, applied every year for 32 years, from 1852 to 1883, the average yield was 15 bushels and 1 peck, with a maximum of 24 bushels and 1 peck in 1854, and a minimum of 5 bushels and 20 quarts in 1879; and with a slight decline in the yield in later years.

With ammonium salts alone, an average yield was obtained of 23 bushels and 28 quarts for the first 16 years, and 17 bushels and 24 quarts for the second 16 years, and an average of 20½ bushels for 32 years.

With nitrate of soda alone, the average yield for the first 16 years was 26 bushels and 20 quarts, and for the second 16 years, 20 bushels and 1 peck, and for the whole 32 years an average of 23½ bushels.

With a regular supply of ammonium salts, superphosphate, and the sulphates of potash, soda and magnesia, the average yearly yield for the first 16 years was 35 bushels and 28 quarts per acre; and during the second 16 years, of 29½ bushels, and during the whole 32 years of 32 bushels and 3 pecks.

Dr. Gilbert demonstrated the conclusions which he reached by numerous tables with the yearly manures and crops of the various plots. And every one listening to him was impressed with the careful study and the pains-taking accuracy with which the Rothamsted experiments have been planned and executed. And the conclusions deduced from them are studied wherever improved agriculture is sought; though variations must be made to suit the conditions of different soils. The soil at Rothamsted is a rather heavy soil and a stiff clay subsoil, with chalk at a great depth below.

REPORT OF LABORATORY WORK FOR 1884.

No. of samples of Complete Fertilizers analyzed, ...	75
" " " Incomplete " "	110
Total, ...	185
No. of samples of Fodders and Feeds Analyzed, . . .	37

Feeding Trials Conducted.

1. Corn Stalks and Corn Meal vs. Corn Ensilage.
2. Moist Brewers' Grains vs. Dried Brewers' Grains.
3. Clover Ensilage vs. Clover Hay.
4. Corn Ensilage vs. Sorghum Ensilage.

Experiments on Growing and Preserving Fodder.

1. Amount of food grown per acre in field corn, including stalks, corn and cobs.
2. Amount of food grown per acre in fodder corn.
3. Expense of growing, harvesting and preserving food from one acre in field corn.
4. Expense of growing, harvesting and preserving in silo food from one acre in fodder corn.
5. Total weight of potash, phosphoric acid and nitrogen contained in product from an acre of field corn.
6. Total weight of potash, phosphoric acid and nitrogen contained in product from an acre in fodder corn.
7. Experiments on the increase of food per acre in fodder corn, at four different dates of one week interval after the appearance of tassels.
8. Experiments on preparing ensilage from corn cut at four different periods of its growth.
9. Sorghum ensilage—losses in process.
10. Sorghum stacked in field as fodder.
11. Effect of fertilizers on sugar formation in sorghum.

Practical Work on Sugar Extraction from Sorghum.

1. History in detail of the Rio Grande Sorghum Works.
2. Determination of losses of sugar during process of extraction from sorghum.
3. Test of Diffusion process for extracting sugar.

Study of Financial Results of Dairy Business.

1. Consumption of food by herd of 32 cows during five months.
2. Cost of food, labor, &c., during this period.
3. Quantity and value of the milk produced.
4. Changes in herd during this period—cows bought and sold.

FERTILIZERS.

During the past year the Station's work in this department has again been to study fertilizers.

I. From a commercial standpoint.

II. From an agricultural standpoint.

I.

QUESTIONS OF COMMERCIAL IMPORTANCE ARE:

1. Statistics of sales of fertilizers consumed in New Jersey during the year ending Nov. 1, 1884.
2. The average retail prices demanded.
3. The wholesale prices of crude stock, out of which merchantable fertilizers are made.
4. The schedule of prices adopted by Stations for computing the relative commercial values of different brands of fertilizers.
5. ☞ Comparison of *Station's Schedule* with the *actual market prices.*
6. Comparison of Station's analyses with manufacturers' guarantees; and comparison of the relative commercial values of different brands.

1.

STATISTICS OF SALES OF FERTILIZERS CONSUMED IN NEW JERSEY DURING THE YEAR ENDING NOV. 1, 1884.

These statistics were taken by manufacturers from their books in answer to request made by this Station. The reports were in each case returned on printed forms, of which the following is a copy:

SALES OF COMMERCIAL FERTILIZERS.

The following is a correct statement of the number of tons of the several classes of Commercial Fertilizers sold in New Jersey by . . . . during the year ending November 1, 1884 :

Number of tons of Complete Manure . . . .
" " Ammoniated Superphosphate without Potash (Dissolved Bone, etc.) . . . .
" " Ground Bone . . . .
" " Kainite . . . .
" " Muriate of Potash . . . .
" " Nitrogenous Matter . . . .
(*a*) Ammonium Sulphate . . . .
(*b*) Sodium Nitrate . . . .
(*c*) Blood, Ammonite, etc . . . .
Number of tons of Plain Superphosphates, including both Dissolved Bone Black and S. C. Acid Phosphate . . . .

Several manufacturers paid no attention to the request for statistics. Reports from forty firms place the total sales at 46,664 tons, compared with 30,163 tons in 1882. The comparison in detail is as follows :

	1882	1884
Number of tons of Completed Manure	15,941	21,894
" " Ammoniated Superphosphate without Potash (Dissolved Bone, etc.) . . .	1,370	1,541
" " Ground Bone	2,509	3,172
" " Kainite	683	991
" " Muriate of Potash	144	291
" " Ammonite	719	783
" " Ammonium Sulphate	76	54
" " Sodium Nitrate	26	40
" " Blood	244	1,581
" " Fish	228	228
" " Hair	248	574
" " Poudrette	3,450	10,200
" " Superphosphates, 30–40 per cent . . .	562	——
" " " 11–18 " . . .	3,963	5,315
Total, ...	30,163	46,664

There is reason to believe that nearly two thousand tons of Superphosphate included in the above was wholesaled by one firm and possibly therefore is included, each year, in the retail returns from other manufacturers.

2.

THE AVERAGE RETAIL PRICES FOR 1882 AND 1884.

	—1882—	—1884—
Complete Manure	$41 00	$38 00
Ammoniated Superphosphate without Potash (Dissolved Bone, etc.)	32 00	31 00
Ground Bone	37 00	36 00
Kainite	12 00	10 00
Muriate of Potash	41 00	38 00
Ammonite	56 00	43 00
Ammonium Sulphate	99 00	70 50
Sodium Nitrate	76 00	54 00
Blood	56 00	43 50
Fish	45 00	31 50
Hair	10 00	11 00
Poudrette	10 00	10 00
Superphosphates with 30 to 40 per cent	75 00	——
" " 11 to 18 "	28 50	24 50

Calculated from the above data, the total value of commercial fertilizers in this State during the year 1884, was *one million three hundred and sixty-nine thousand and four dollars* ($1,369,004), compared with *one million and seventy thousand, one hundred and thirteen dollars* ($1,070,113) in 1882.

3.

WHOLESALE PRICES OF CRUDE STOCK AT NEW YORK, DURING THE YEAR ENDING JAN. 1, 1885.

The weekly reports of the wholesale market, published by the *Oil, Paint and Drug Reporter*, are the sources of the following averages:

In making up this table, nitrate of soda has been assumed to contain *sixteen per cent.*, and sulphate of ammonia *twenty and one-half* per cent. of *nitrogen;* these figures being close approximations to the average composition of samples analyzed at this station.

The quotations for azotine and dried blood are given for each *unit of ammonia.* A *unit* is a trade term for twenty pounds; a *unit of ammonia*, consequently, is equivalent to *sixteen and one-half pounds of nitrogen*. No quotations of phosphoric acid are obtained; although, to a certain extent, it is also bought and sold per unit of available acid. As only ton prices for superphosphate have been given without guarantees, their use has, of course, been prevented in this table.

Muriate of potash is usually guaranteed to carry fifty per cent., and kainite twelve and one-half per cent. of actual potash.

Both of these guarantees are below the Station's average analysis, and consequently the prices given per pound of potash may be somewhat higher than actual market rates:

Wholesale Prices at New York During the Year 1884.

Months.	Cost per Pound of Nitrogen, in Form of—								Cost per Pound of Potash in—			
	Nitrate of Soda.		Sulphate of Ammonia.		Azotine.		Dried Blood.		Muriate of Potash.		Kainite.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
January	14.8	14.2	17.1	15.1	13.7	12.9	13.7	12.1	3.4	3.1	3.5	3.2
February	14,6	14.2	15.7	14.5	14.0	13.1	14.0	12.9	3.4	3.1	3.1	3.0
March	14.4	13.7	15.2	14.1	14.0	13.3	13.8	13.1	3.5	3.3	3.2	3.1
April	14.1	13.6	14.8	14.1	13.7	13.2	14.0	13.3	3.5	3.3	3.1	2.9
May	14.1	13.4	16.1	14.5	14.0	13.7	14.4	13.7	3.5	3.3	3.3	3.1
June	14.1	12.8	14.8	14.5	13.7	13.4	13.8	13.3	3.5	3.3	3.4	3.1
July	14.1	13.4	15.0	14.6	13.7	13.3	13.7	12.3	3.5	3.3	2.9	2.9
August	14.4	13.5	15.0	14.5	13.4	13.2	13.7	13.1	3.5	3.3	3.1	3.0
September	14.4	13.8	14.6	14.1	13.4	13.2	13.2	12.5	3.5	3.2	3.0	2.9
October	14.1	13.5	15.4	14.5	13.4	12.9	13.7	12.4	3.5	3.2	2.6	2.5
November	14.1	13.5	15.9	14.5	12.8	12.1	12.6	11.7	3.4	3.1	2.6	2.5
December	14.1	13.4	15.8	14.6	12.7	12.7	12.3	11.5	3.4	3.3	2.8	2.7

4.

THE SCHEDULE OF PRICES ADOPTED BY STATIONS FOR COMPUTING THE RELATIVE COMMERCIAL VALUES OF FERTILIZERS.

The Directors and Chemists of the Experiment Stations of Massachusetts, Connecticut and New Jersey, are accustomed to meet in convention on the first day of March in each year. They then adopt a schedule of prices to be used during the following season in computing the *relative commercial values* of different brands of fertilizers. As this schedule is based upon wholesale market quotations, noticeable variations of course occur from year to year, as the following table indicates :

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	Cents per pound.			
	1881.	1882.	1883.	1884.
Nitrogen in Ammonia Salts	22½	29	26	22
" " Nitrates	26	26	20	18
" " Dried and fine ground fish	20	24	23	20
Organic Nitrogen in guano, dried and fine ground blood and meat	20	24	23	18
" " " cotton seed and linseed meal and in castor pomace . . .	16	18	18	18
" " " fine ground bone	15	17	17	18
" " " fine medium bone	14	15	15	16
" " " medium bone	13	14	14	14
" " " coarse medium bone	12	13	13	12
" " " coarse bone, horn shavings, hair and fish scrap	11	11	11	10
Phosphoric Acid, soluble in water	12½	12½	11	10
" " soluble in ammonium citrate* .	9	9	8	9
" " insoluble, in dry fine ground fish and in fine bone . .	6	6	6	6
" " " " fine medium bone .	5½	5½	5½	5½
" " " " medium bone . . .	5	5	5	5
" " " " coarse medium bone	4½	4½	4½	4½
" " " " coarse bone	4	4	4	4
" " " " fine ground rock-phosphate	3½	3	2¾	2¼
Potash as high grade sulphate	7½	7	7	7¼
" " Kainite	5½	5	4¼	4¼
" " Muriate	4½	5	4¼	4¼

*Dissolved from two grams of the Phosphate, unground, by 100 c. c. neutral solution of Ammonium Citrate, sp. gr. 1.09 in 30 minutes, at 40 deg. C., with agitation once in five minutes commonly called "reverted" or "backgone" Phosphoric Acid.

The above trade values are the figures at which on March 1st the respective ingredients could be bought at retail, for cash in our markets in the *raw materials* which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations. The calculated values obtained by use of the above figures will be found to agree fairly with the reasonable retail price in case of standard raw materials such as:

Sulphate of Ammonia,
Nitrate of Soda.
Muriate of Potash.
Sulphate of Potash.
Dried Blood.
Azotine.
Dry Ground Fish.
Cotton Seed.
Castor Pomace.
Bone.
Plain Superphosphates.

5.

COMPARISONS OF THE STATION'S SCHEDULE WITH ACTUAL MARKET PRICES.

As stated above, it was intended upon the first day of March, 1884, that this schedule should represent the actual retail prices then ruling in New York, for the nitrogen, phosphoric acid and potash in unmixed goods.

From time to time during the year, the Station's chemist sampled large stocks of these materials in the factories of leading manufacturers, and in each case was immediately informed, by letter, as to the prices at which these goods would then be retailed.

These prices, coupled with the analysis of the samples, furnish the data for the *manufacturers' average retail cash prices*, given in the following table:

	Manufacturers' Average Retail Prices for		Stations Schedule of Prices for
	1883.	1884.	1884.
Cost per pound of Nitrogen from Nitrate of Soda	19.7c	16.9c	18c
" " " " " " **Sulphate of Ammonia**	20.8	17.1	22
" " " " " " **Dried Blood**	21.1	18.3	18
" " " " " " **Ammonite and Tankage**	20.6	15.8	18
" " " " **Soluble Phosphoric Acid from Bone Black**	9.	7.3	10
" " " " " " " " **S. C. Rock**	10.	8.6	10
" " " " **Reverted** " " " **Bone Black**	6.5	6.7	9
" " " " " " " " **S. C. Rock**	7.3	7.8	9
" " " " **Insoluble** " " " **Bone Black**	3.3	2.9	4
" " " " " " " " **S. C. Rock**	2.6	1.9	2¼
" " " " **Potash from High Grade Sulphate**	7.2	7.2	7¼
" " " " " " **Kainit**	4.5	4.	4¼
" " " " " " **Muriate**	4.2	3.7	4¼

The comparison of the Station's schedule with manufacturers' average retail prices, indicates that there is no cause for complaint. Dealers can see that competition has forced their prices below stations' rates, and farmers who have been influenced by stations' estimates can see that they have not been misled.

The analysis and prices upon which the manufacturers' averages in the above table are based, can be found on the following pages:

NITRATE OF SODA, SULPHATE OF AMMONIA AND DRIED BLOOD.

Furnishing Nitrogen.

Station Number.	Nitrate of Soda.	Percentage of Nitrogen.	Cost of Nitrogen per lb.	Cost of 2,000 lbs of Nitrate of Soda.
612	Harrison Bros., Philadelphia	16.17	18.6c	$60.00
616	Mapes F. and P. Guano Co., New York	16.10	15.5	50.00
640	Pennsylvania Salt Co., Philadelphia	15.85	16.5	52.50
740	Geo. B. Forrester, New York	16.12	17.1	55.00
746	H. J. Baker Bros., New York	16.15	16.2	52.50
755	Lister Bros., Newark	16.08	16.8	54.00
768	Bowker Fertilizer Co., Boston	15.79	15.8	50.00
771	Williams, Clark & Co., New York	15.87	18.9	60.00
783	E. Frank Coe, New York	15.91	16.4	52.00

Average Cost per Pound of Nitrogen, in Nitrate of Soda 16.9c

Station Number.	Sulphate of Ammonia.	Percentage of Nitrogen.	Cost of Nitrogen per lb.	Cost of 2,000 lbs. of Sulphate of Ammonia.
611	Harrison Bros., Philadelphia	20.90	17.9c	$75.00
682	Baugh & Sons, Philadelphia	20.64	18.2	75.00
738	George B. Forrester, New York	20.97	15.5	65.00
745	H. J. Baker Bros., New York	20.08	18.7	75.00
756	Lister Bros., Newark	20.65	15.7	65.00
767	Bowker Fertilizer Co., Boston	20.69	15.7	65.00
775	Williams, Clark & Co., New York	20.88	19.2	80.00
778	E. Frank Coe, New York	20.74	15.6	65.00

Average Cost per Pound of Nitrogen, in Sulphate of Ammonia 17.1c

Station Number.	Dried Blood.	Percentage of Nitrogen.	Cost of Nitrogen per lb.	Cost of 2,000 lbs. of Dried Blood.
760	Lister Bros., Newark	13.86	16.2c	$45.00
773	Williams, Clark & Co., New York	10.34	21.8	45.00
777	E. Frank Coe., New York	10.67	19.7	42.00
793	M. L. Shoemaker & Co., Philadelphia	13.50	15.6	42.00

Average Cost per Pound of Nitrogen, in Dried Blood 18.3c

AMMONITE, TANKAGE, DRIED FISH, PORPOISE SCRAP, CASTOR POMACE AND HAIR MANURE.

Furnishing Nitrogen in the form of Organic Matter.

Ammonite and Tankage.

Station Number.	Manufacturer.	Percentage.		Cost per lb.		Cost of 2,000 lbs. of Fertilizer.
		Nitrogen.	Phosphoric Acid.	Nitrogen.	Phosphoric Acid.	
610	John Taylor & Co., Trenton, Tankage	4.51	10.36	1.4c	6c	$25.00
678	Baugh & Sons, Philadelphia, A. A. Nitrogen	11.03	2.84	18.9	6	45.00
791	M. L. Shoemaker, Philadelphia, Ammonite A	13.71	1.31	15.8	6	45.00
792	" " " " B	11.84	3.58	14.6	6	39.00
	Average Cost of Nitrogen per Pound			15.8		

Dried Fish and Porpoise Scrap.

Station Number.	Manufacturer.	Percentage.		Cost per lb.		Cost of 2,000 lbs. of Fertilizer.
		Nitrogen.	Phosphoric Acid.	Nitrogen.	Phosphoric Acid.	
608	Cape May Porpoise Fishing Co.. Porpoise Scrap..	12.00	0.64	....	....	....
761	Lister Bros., Dried Fish..................................	9.22	6.89	10.7c	6c	$28.00
763	Bowker's Dried Fish	8.98	7.68	14.3	6	35.00

Castor Pomace and Hair Manure.

Station Number.	Manufacturer.	Percentage.		Cost per lb.		Cost of 2,000 lbs. of Fertilizer.
		Nitrogen.	Phosphoric Acid.	Nitrogen.	Phosphoric Acid.	
607	Hair Manure, Wm. Parry, Agent..................	5.31	....	10.3c	....	$11.00
752	H. J. Baker, Bros., Castor Pomace	4.15	1.87	20.2	6c	19.00

PLAIN SUPERPHOSPHATES—From Bone Black and Bone Ash.

Station No.	BRAND.	MANUFACTURER.	SAMPLED BY
736	Bone Black Superphosphate	Lister Bros., Newark.	Chemist of Station.
743	" " "	Geo. B. Forrester, N. Y.	" " "
749	" " "	H. J. Baker & Bro., N. Y.	" " "
766	" " "	Bowker Fertilizer Co.	" " "
772	" " "	Williams, Clark & Co., N. Y.	" " "
782	" " "	E. Frank Coe, N. Y.	" " "
790	Dissolved Bone Ash…………	M. L. Shoemaker & Co., Phil.	" " "

From South Carolina Rock, etc.

Station No.	BRAND.	MANUFACTURER.	SAMPLED BY
614	Acidulated Phosphate Rock	Harrison Bros., Philadelphia	Charles Collins, Fellowship, N. J.
622	Acid Phosphate…………………	Williams, Clark & Co., N. Y.	A. P. Arnold, Vineland, N. J.
648	Dissolved S. C. Rock …………	M. L. Shoemaker & Co., Phila.	L. Mortimer, Vineland, N. J.
653	Acid Phosphate …………………	Bowker Fertilizer Co.	J. V. D. Christopher, New Brunswick, N. J.
671	Soluble Bone Phosphate……	Moro Phillips, Camden.	H. I. Budd, Mt. Holly.
680	Acid Phosphate…………………	Baugh & Son, Phila.	" " " "
699	W. & C. Acidulated Phos……	N. J. Chemical Co., Camden	" " " "
703	Philadelphia Standard Phos.	U. S. Chemical Co., "	" " " "
705	Acid Phosphate…………………	Coe & Richmond, N. J.	" " " "
707	Acidulated Bone Phosphate	" " "	" " " "
747	High Grade Superphosphate	Packard, Ipswich, England. H. J. Baker & Bro., Dealers.	Chemist of Station.
769	Acid Phosphate…………………	Bowker Fertilizer Co.	" " "
774	" " …………………	Williams, Clark & Co., N. Y.	" " "
789	" " …………………	M. L. Shoemaker & Co., Phila.	" " "

PLAIN SUPERPHOSPHATES.

Furnishing Soluble, Reverted and Insoluble Phosphoric Acid.

From Bone Black and Bone Ash.

Station Number.	Manufacturer.	Phosphoric Acid.					Cost per pound.			Cost of 2,000 lbs. of Fertilizer.
					Available		Phosphoric Acid.			
		Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Found.	Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	
736	Lister Bros., Newark....................	18.15	....	0.16	18.15	18.00	6.9c	....	2.8c	$25.00
743	Geo. B. Forrester, New York........	18.14	0.10	0.12	18.24	....	7.4	6.7c	3.0	27.00
749	H. J. Baker & Bro., New York......	15.27	0.43	0.04	15.70	16.00	7.7	6.9	3.1	24.00
766	Bowker Fertilizer Co., Boston....	17.56	....	0.08	17.58	....	....	....	....	....
772	Williams, Clark & Co., New York,	14.59	4.98	1.47	19.57	15.00	7.1	6.4	2.9	28.00
782	E. Frank Coe, New York...............	12.48	4.94	1.65	17.42	....	7.4	6.7	3.0	26.00
790	M. L .Shoemaker & Co., Phila.......	16.58	0.42	0.13	17.00	17.00	7.4	6.6	2.9	25.00
	Average Cost per lb. of Phos. Acid from Bone Black						**7.3c**	**6.7c**	**2.9c**	

From South Carolina Rock.

Station Number.	Manufacturer.	Phosphoric Acid.					Cost per pound.			Cost of 2,000 lbs. of Fertilizer.
					Available		Phosphoric Acid.			
		Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Found.	Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	
614	Harrison Bros., Philadelphia.......	6.30	2.84	8.80	9.14	....	8.1c	7.3c	1.8c	$17.50
622	Williams, Clark & Co., New York,	7.19	3.72	3.78	10.91	11.00	8.8	8.0	2.0	20.00
648	M. L. Shoemaker & Co., Phila., ...	8.04	2.62	4.80	10.66	12.00	7.9	7.1	1.8	18.00
653	Bowker Fertilizer Co., Boston......	11.00	1.32	3.62	12.32	10.00	7.0	6.3	1.6	18.00
671	Moro Phillips, Camden	7.94	2.98	5.13	10.92	12.00	7.7	6.9	1.7	18.00
680	Baugh & Sons, Philadelphia.........	8.70	3.14	2.88	11.84	12.00	7.5	9.7	1.7	18.00
699	N. J. Chemical Co., Camden.........	12.13	1.70	3.24	13.83	13.00	8.8	7.9	2.0	25.00
703	U. S. Chemical Co., Camden..........	5.23	4.97	4.18	10.20	12.00	10.8	9.8	2.4	23.00
705	Coe & Richmond, Mantua Point,	9.92	2.20	2.83	12.12	12.00	9.6	8.7	2.2	24.00
707	" " " "	5.25	2.29	3.75	7.54	8.00	13.5	12.2	3.1	22.00
747	H. J. Baker & Bro., New York	38.75	4.66	0.93	43.41	43.00	8.0	7.2	1.8	69.00
769	Bowker Fertilizer Co., Boston.....	10.33	1.73	4.27	12.06	10.00	7.1	6.4	1.6	18.00
774	Williams, Clark & Co., New York,	9.92	1.68	2.58	11.60	11.00	8.4	7.6	1.9	20.00
789	M. L. Shoemaker & Co., Phila......	7.49	3.60	5.07	11.09	12.00	7.6	6.9	1.7	18.00
	Average Cost per lb. of Phos. Acid from S. C. Rock						**8.6c**	**7.8c**	**1.9c**	

POTASH SALTS.

Station Number.	Muriate of Potash.	Percentage of Potash.	Cost of Potash per Pound.	Cost of 2,000 lbs. of Muriate.
615	Harrison Bros., Philadelphia	54.48	4.1c	$45.00
649	Kimball, Prince & Co., Vineland	54.05	3.5	37.50
657	Mapes F. and P. Guano Co., New York	51.52	3.6	37.00
731	" " " " "	51.90	3.6	37.00
732	E. Frank Coe, New York	53.00	3.5	37.00
739	Geo. B. Forrester, New York	51.48	3.6	37.50
748	H. J. Baker & Bro., New York	51.73	3.6	37.50
758	Lister Bros., Newark	53.24	3.6	38.00
762	Bowker Fertilizer Co., Boston	53.66	3.5	37.00
780	E. Frank Coe, New York	49.16	3.8	37.00
788	M. L. Shoemaker & Co., Philadelphia	51.19	3.9	40.00
	Average Cost of Potash per Pound, in Muriate		**3.7c**	

Station Number.	Kainit.	Percentage of Potash.	Cost of Potash per Pound.	Cost of 2,000 lbs. of Kainit.
737	Wm. Bumm & Sons, Philadelphia	12.67	3.9c	$10.00
751	H. J. Baker & Bro., New York	13.51	3.9	10.50
757	Lister Bros., Newark	13.95	3.6	10.00
764	Bowker Fertilizer Co., Boston	13.08	3.8	10.00
770	Williams, Clark & Co., New York	12.42	4.8	12.00
781	E. Frank Coe, New York	12.27	4.1	10.00
787	M. L. Shoemaker & Co., Philadelphia	13.33	3.8	10.00
	Average Cost per Pound of Potash, in Kainit		**4.0c**	

Station Number.	High Grade Sulphate.	Percentage of Potash.	Cost of Potash per Pound.	Cost of 2,000 lbs. of Sulphate.
744	George B. Forrester, New York	23.42	7.5c	$35.00
750	H. J. Baker & Bro., New York	24.52	7.1	35.00
765	Bowker Fertilizer Co., Boston	23.12		
776	Williams, Clark & Co., New York	21.35	7.3	31.00
779	E. Frank Coe, New York	22.91	7.0	32.00
	Average Cost per Pound of Potash, in Sulphate		**7.2c**	

6.

COMPARISON OF STATION'S ANALYSES WITH MANUFACTURERS' GUARANTEES, AND A COMPARISON OF THE RELATIVE COMMERCIAL VALUES OF DIFFERENT BRANDS.

Classified lists of the chemicals and crude materials used in compounding Complete Fertilizers, have been given upon preceding pages.

The great variations in the proportions of plant food in the same materials drawn from different sources, indicate that similar variations may easily occur in complete manures made from such articles. Twelve years ago these variations were so great that laws were enacted in many States, requiring manufacturers to guarantee the composition of each package of their goods. The law and its supplement at present in force in New Jersey, can be found complete at the end of this Report. As one case, however, has recently been brought to the notice of the Station, where doubtless through ignorance, a provision of this act was violated, it has been deemed best to reprint the following sections.

AN ACT TO REGULATE THE MANUFACTURE AND SALE OF FERTILIZERS.

1. That every commercial fertilizer which shall be offered for sale in this State shall be accompanied by an analysis, stating the percentage therein of ammonia, or its equivalent of nitrogen; of potash, in any form or combination, soluble in distilled water; and of phosphoric acid in any form or combination; the portion of phosphoric acid soluble in distilled water; that portion soluble in a neutral solution of citrate of ammonia at a temperature not exceeding one hundred degrees Fahrenheit; and that portion of phosphoric acid not soluble in either of the above named fluids, shall each be determined separately; and the material from which the phosphoric acid is obtained shall also be stated; a legible statement of such analysis shall accompany all packages or lots of over one hundred pounds, sold, offered or exposed for sale.

5. *And be it enacted*, That any person selling, offering or exposing for sale any commercial fertilizer without any analysis required

by the first section of this act, or the act to which this act is a supplement, or with an analysis stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense; *provided further*, that the provisions of this section, or the act to which this act is a supplement, shall not apply to any manure sold at a price not exceeding one-half a cent per pound, nor to any imported guanos.

STATION'S METHOD OF CONTROLLING THE QUALITY OF FERTILIZERS.

Experience has demonstrated that the interests both of farmers and of reputable manufacturers, can be best protected

1. By comparing the Station's analysis of a brand with its manufacturer's guarantee.
2. By distributing the published reports of these comparisons among producers and consumers.
3. By providing for an easy and fair comparison between the complete fertilizers from different works. This is done by the use of *relative commercial values.*

SAMPLING.

The greatest care is observed in accepting samples for analysis. Nearly all received this year have been drawn by request, and according to printed regulations, by the following gentlemen, representing the responsible farmers in their sections of this State:

Isaac W. Nicholson of Camden.
Henry I. Budd of Mount Holly.
David C. Voorhees of Blawenburgh.
J. V. D. Christopher of New Brunswick.

GUARANTEES.

Samples analyzed this season, in five cases out of six, contain more plant food than their minimum guarantees demand. They are better than their manufacturers claim.

The failure to keep guarantees in two or more brands was probably caused by careless work at the factories; an abnormally high per centage of one ingredient explaining a deficiency in another.

In some instances, however, especially where the guaranteed analyses of available phosphoric acid are much higher than the Station's results, the differences are doubtless due to chemical methods followed: one process, digesting at 150 deg. fahr., now often used in manufacturers' laboratories, giving results which cannot be obtained when the law of this State, digesting at 100 deg. fahr., is properly observed. Sample No. 617 illustrates this fact; it contains more nitrogen, potash and *total* phosphoric acid than its manufacturers claimed, but for the above reason, in *available* phosphoric acid it falls two per cent. below its guarantee.

SELLING PRICES AT FACTORIES.

These prices are intended to cover the cost of retailing as well as the expenses of grinding, mixing, bagging and delivering the fertilizers on cars or boat. They do not include transportation or freight charges.

In many cases these prices could not be obtained. Several manufacturers failed to understand what was wanted; a few positively refused to publish their lists.

VALUE PER TON, 2,000 POUNDS, AT STATION'S PRICES.

It has been already stated that *Station's prices* were intended to represent the retail cash cost, on the first of March, 1884, of the nitrogen, phosphoric acid and potash in chemicals and unmixed fertilizers.

It has also been shown that since that date there has been a steady decline in wholesale prices; and it has been proved further, that there have been manufacturers in both New York and Philadelphia, ready to retail chemicals and unmixed materials at prices below the Station's figures.

Value per ton, 2,000 pounds, at Station's prices, therefore, when applied to complete fertilizers, are intended

1st. To afford an easy and fair method of comparing one brand with another.

2nd. To show consumers the retail cash cost at the manufactory, of the unmixed goods from which the complete fertilizers were made.

When a fertilizer is offered for sale, the farmer should first learn the freight rate between his depot and that of the manufacturer. By subtracting this rate from the price asked, he can find out the manufacturer's *selling price at the factory.* A comparison then, between selling price at the factory and Station's price for the same brand, will show the consumer how much expense is incurred in passing plant food through the hands of parties who mix and retail complete fertilizers.

COMPLETE FERTILIZERS.

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station Number.	BRAND.	MAUFACTURER.	SAMPLED BY	Station Number.
617	Selected Esmeralda Bird Guano	Equitable Fertilizing Co., Baltimore.	J. V. D. Christopher, New Brunswick.	617
619	Bowker's A. B. Phosphate	Bowker Fertilizer Co., Boston.	" " " "	619
638	Bowker's Hill and Drill	" " " "	Hon. I. W. Nicholson, Camden.	638
639	Bowker's Stockbridge Manure	" " " "	" " " "	639
620	Smith's Bone Phosphate	John I. Smith, Trenton.	J. V. D. Christopher, New Brunswick.	620
623	Wenderoth's Guano	Adam Wenderoth, Camden.	E. F. Keen, Cramer's Hill.	623
624	Peruvian Guano No. 1, Guaranteed	Hurtado & Co., New York.	Ellisson T. Leap, Hurffville.	624
627	Peruvian Guano Lobos	" " " "	Hon. I. W. Nicholson, Camden.	627
625	Great Planet Formula A	Clark's Cove Guano Co., New Bedford.	" " " "	625
722	Bay State	" " " " " "	C. H. Olden, Princeton.	722
628	Yarnell's Bone Phosphate	New Jersey Chemical Co., Camden	Hon. I. W. Nicholson, Camden.	628
695	Yarnell's Bone Fertilizer	" " " " "	H. I. Budd, Mount Holly.	695
701	Yarnell's High Grade Fertilizer	" " " " "	" " " "	701
629	Mapes' Dried Ground Fish, Special	Mapes' F. and P. Guano Co., New York.	Hon. I. W. Nicholson, Camden.	629
630	Mapes' A Brand	" " " " "	" " " "	630
633	Mapes' Potato Manure	" " " " "	" " " "	633

COMPLETE FERTILIZERS.

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station Number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 lbs. at Station Prices.	Selling Price of 2,000 lbs. at Factory.	Station Number.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phos. Acid Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
617	Selected Esmeralda Bird Guano	0.82	2.07	1.90	4.79	4.13	0.18	3.74	13.74	17.66	15.13	3.92	6.00	2.67	2.00	2.77	41.39		617
619	Bowker's A. B. Phosphate			1.37	1.37	1.64	7.76	1.63	4.63	14.02	10.00	9.39	7.00	1.33	1.10	1.40	29.23		619
638	“ Hill and Drill		0.46	1.53	1.99	2.05	7.09	0.97	2.18	10.24	10.00	8.06	8.00	1.86	1.08	4.32	27,61		638
639	“ Stockbridge Manure for Potatoes		1.42	1.93	3.35	3.25	8.06	0.29	1.83	10.18	8.00	8.35	7.00	3.80	5.00	3.37	35.49		639
620	Smith's Bone Phosphate			1.60	1.60	1.64	3.95	3.99	3.84	11.78	10.00	7.94		3.44	3.00	6.70	27.86		620
623	Wenderoth's Guano			1.42	1.42		2.87	3.00	6.50	12.37		5.87		0.15			22.80		623
624	Peruvian Guano No. 1, Guaranteed	0.17	4.12	1.64	5.93	5.35	3.01	8.50	7.20	18.71	17.00	11.51	15.00	3.32	3.00	0.70	57.35	58.00	624
627	“ “ Lobos	0.18	4.15	0.74	5.07	4.12	1 40	8.34	5.88	15.62	15.00	9.74		2.99		1.74	47.92	44.50	627
625	Clark's Cove Co.'s Great Planet A		1.61	1.43	3.04	2.46	6.91	0.75	1.15	8.81		7.66	7.00	8.82	9.00	4.39	38.31		625
722	“ “ “ Bay State	0.77	1.02	1.61	3.40	2.47	8.47	1.56	1.57	11.60		10.03	10.00	3.42	2.00	3.72	37.76		722
628	Yarnell's Bone Phosphate		0.96	2.19	3.15	3.29	6.63	1.81	2.62	11.06	10.00	8.44		4.71	5.00	4.22	35.86		628
695	“ “ Fertilizer		0.20	1.44	1.64	1.64	5.12	2.11	3.75	10.98	11.00	7.23		5.92	8.00	5.63	29.09		695
701	“ High Grade Fertilizer		1.00	1.99	2.99	3.29	6.56	1.90	2.22	10.68	11.00	8.46		4.90	5.00	4.26	35.07		701
629	Mapes' Dried Ground Fish, Special		0.32	3.98	4.30	4.11	0.58	5.20	4.25	10.03	6.00	5.78		3.21	8.00	5.58	34.41	35.00	629
630	“ A Brand	0.72	0.66	1.47	2.85	2.46	5.25	6.34	2.93	14.52	12.00	11.59	10.00	2.65	2.50	2.59	38.17	38.00	630
633	“ Potato Manure	0.75	2.11	1.31	4.17	3.69	6.35	4.39	2.83	18.57		10.74	8.00	7.23	6.00	4.43	47.84	50.00	633

COMPLETE FERTILIZERS.

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station Number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station Number.
651	Mapes' Nitrogenized Superphosphate	Mapes' F. and P. Guano Co., New York.	J. V. D. Christopher, New Brunswick.	651
677	Mapes' Corn Manure	" " " " " "	" " " "	677
634	La Vuelta	P. Zell & Sons, Baltimore.	Hon. I. W. Nicholson, Camden.	634
635	Plow Brand, Raw Bone Superphosphate	Walton, Whann & Co., Wilmington.	" " " "	635
637	N. J. Chemical Co.'s Acidulated Fish Guano	New Jersey Chemical Co., Camden.	" " " "	637
693	" " " Soluble Bone and Potash	" " " " "	H. I. Budd, Mount Holly.	693
698	" " " W. and C. Superphosphate	" " " " "	" " " "	698
700	" " " Button Bone	" " " " "	" " " "	700
641	Ammoniated Dissolved Bone	E. Frank Coe, New York.	J. V. D. Christopher, New Brunswick.	641
642	Alkaline Bone	" " " "	" " " "	642
643	High Grade Ammoniated Dissolved Bone	" " " "	" " " "	643
645	Ralston's Potato Manure	" " " "	" " " "	645
725	Ralston's Knickerbocker	" " " "	C. C. Vermeule, New Brunswick.	725
647	Ammoniated Bone Superphosphate	Russell Co, Linden.	J. G. Hagamen, Rocky Hill.	647
660	Flesh and Blood Fertilizer	B. Ruckman, Adams Station.	Arnold Farmer, New Brunswick.	660
662	Lister's U. S. Phosphate	Lister Bros., Newark.	J. V. D. Christopher, New Brunswick.	662

COMPLETE FERTILIZERS.

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station Number.		Nitrogen.					Phosphoric Acid.							Potash.					
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phos. Acid Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.	Chlorine.	Value of 2,000 lbs. at Station Prices.	Selling Price of 2,000 lbs. at Factory.	Station Number.
651	Mapes' Nitrogenized Superphosphate	0.96	0.33	1.31	2.60	2.05	9.46	1.26	2.56	13.28	11.00	10.72	9.00	2.99	2.50	3.72	36.18	35.00	651
677	" Corn Manure	0.62	1.93	1.17	3.72	3.69	6.82	3.86	3.14	13.82	10.00	10.68		6.40	6.00	6.08	44.26	48.00	677
634	Zell's La Vuelta	0.37	1.18	0.11	1.66	1.85	6.20	1.22	1.56	8.98	7.50	7.42	6.00	9.16	6.00	12.49	30.75		634
635	Walton & Whann's Plow Brand		0.15	2.33	2.48	2.05	5.84	3.63	2.82	12.29	11.00	9.47	9.00	2.42	2.00	2.30	32.79	35.00	635
637	N. J. Chemical Co.'s Acidulated Fish Guano		0.77	1.67	2.44	2.05	4.35	1.93	4.57	10.85	10.00	6.28		2.07	1.50	2.07	28.11		637
693	" " " Soluble Bone and Potash			0.10	0.10		4.49	4.08	5.59	14.16	13.00	8.57		1.48	1.50	2.62	23.02		693
698	" " " W. and C. Superphosphate		0.10	1.21	1.31	2.05	6.02	1.86	6.69	14.57	11.00	7.88		0.73	1.50	1.15	27.31		698
700	" " " Button Bone		0.62	0.74	1.36	1.44	2.78	2.84	4.62	10.24	11.50	5.62	10.00	5.47	2.50	7.73	25.17		700
641	E. Frank Coe's Ammoniated Dissolved Bone		0.08	1.56	1.64	1.23	7.96	1.28	3.23	12.47	9.00	9.24	8.00	1.31	1.08	1.42	28.83	29.00	641
642	" " Alkaline Bone		0.08	0.90	0.98	0.82	7.86	1.08	2.81	11.75	10.00	8.94	9.00	2.10	1.62	1.74	25.92	27.00	642
643	" " High Grade Ammon. Dis. Bone		0.65	1.45	2.10	2.05	8.16	0.99	2.09	11.24	10.00	9.15	9.00	1.58	1.08	0.25	30.82	32.00	643
645	Ralston's Potato Manure		0.24	1.61	1.85	1.64	7.78	0.91	3.26	11.94	10.00	8.69	8.00	3.77	3.78	1.60	31.80	39.00	645
725	" Knickerbocker		0.60	1.62	2.22	2.05	7.62	1.34	2.07	11.03		8.96	9.00	2.00	1.10	0.30	31.29		725
647	Russell Coe's Ammon. Bone Superphosphate		0.16	1.72	1.88	1.85	5.27	1.19	4.62	11.08	11.00	6.46	9.00	1.57	1.50	2.77	25.76		647
660	Ruckman's Flesh and Bone Fertilizer			3.27	3.27			5.31	5.41	10.72		5.31		1.70		3.45	28.96		660
662	Lister Bros.' U. S. Superphosphate		0.48	0.82	1.30	1.81	4.94	1.57	0.79	7.30	7.00	6.51	6.00	2.75	2.00	6.10	21.16	25.25	662

COMPLETE FERTILIZERS.

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station Number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station Number.
661	Lister's Standard Superphosphate	Lister Brothers, Newark.	J. V. D. Christopher, New Brunswick.	661
676	Lister's Ammoniated Dissolved Bone	" " "	" " " "	676
663	Barren Island Guano	P. White & Sons, New York.	" " " "	663
675	Farmer's Pride	" " "	" " " "	675
664	Clancy's Pure Bone Phosphate	Terry Clancy, New Brunswick.	" " " "	664
667	Swift Sure Superphosphate	M. L. Shoemaker & Co., Philadelphia.	H. I. Budd, Mount Holly.	667
669	Quaker City Poudrette	Quaker City Poudrette Co., Philadelphia.	" " " "	669
670	Pure Phuine	Moro Phillips, Camden.	" " " "	670
672	Genuine Improved Superphosphate	" " "	" " " "	672
673	Imperial Phosphate	Sharpless & Carpenter, Philadelphia.	" " " "	673
681	New Process Ten per cent. Guano	Baugh & Sons, Philadelphia.	" " " "	681
686	Special for Tobacco	" " "	" " " "	686
688	Cabbage Manure	George B. Forrester, New York.	A. W. Duryee, New Durham.	688
689	Potato Manure	" " " "	" " " "	689
690	Corn Manure	" " " "	" " " "	690
691	National Complete	U. S. Chemical Co., Camden.	H. I. Budd, Mount Holly.	691

COMPLETE FERTILIZERS.

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station Number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 lbs. at Station's Prices.	Selling Price of 2,000 lbs. at Factory.	Station Number.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phos Acid Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.				
661	Lister Bros.' Standard Superphosphate		0.83	1.52	2.35	2.34	8.96	2.68	1.26	12.90	12.00	11.64	10.00	1.95	1.50	1.77	35.29	34.25	661
676	" " Ammoniated Dissolved Bone......		0.58	1.47	2.05	1.64	8.23	2.57	1.28	12.08	10.00	10.80	8.00	1.68	1.50	2.28	31.67	29.00	676
663	P. White & Sons' Barren Island Guano		0.33	2.54	2.87	2.46	6.89	0.80	2.83	10.52	13.30	7.69		3.22		2.96	32.12		663
675	" " " Farmers' Pride....................		0.34	2.33	2.67	2.46	7.62	1.16	2.25	11.03	11.50	8.78		1.08	2.00	1.57	31.10		675
664	Clancy's Pure Bone Phosphate			1.17	1.17	1.64	4.12	1.77	3.33	9.22	8.00	5.89		0.70	2.00	1.52	19.68		664
667	Shoemaker's Swift Sure Superphosphate.........	0.47	0.14	2.64	3.25	2.46	7.40	3.26	2.50	13.16	14.50	10.66	9.00	5.15	4.00	4.09	40.70	38.00	667
669	Quaker City Poudrette		0.28	1.02	1.30	1.23		2.60	0.27	2.87	6.00	2.60		1.87	3.00	3.43	11.82		669
670	Moro Phillips' Pure Phuine..............................		0.14	2.00	2.14	1.64	5.02	1.42	3.67	10.11		6.44	7.00	2.55	2.00	0.45	27.75	35.00	670
672	" " Genuine Improved Superphos.			2.10	2.10	1.64	6.08	2.90	3.87	12.85	14.70	8.98	10.00	2.60	2.16	0.54	32.60	35.00	672
673	Sharpless & Carpenter's Imperial Phosphate..		0.10	2.40	2.50	2.46	3.68	8.72	6.95	19.35		12.40	10.00	3.60	3.00	3.05	42.42	45.00	673
681	Baugh's New Process 10 per cent. Guano.........		6.28	1.24	7.52	8.20	1.38	4.92	3.09	9.89	9.18	6.30		4.47	4.00	3.28	50.79	60.00	681
686	" Special for Tobacco		0.10	4.61	4.71	4.10	3.84	2.02	2.46	8.32		5.86	4.60	2.25	2.16	4.79	34.42	38.00	686
688	Forrester's Cabbage Manure............................	0.21	5.68	0.27	6.16	4.50	6.05	0.15		6.20	8.00	6.20		9.50	6.50	7.54	47.26	50.00	688
689	" Potato Manure		4.31		4.31	3.50	6.72	0.57	0.70	7.99	5.50	7.29		9.34	10.00	4.29	44.19	48.00	689
690	" Corn Manure......		4.43		4.43	3.25	7.30	0.25	0.64	8.19	7.00	7.55		9.40	8.50	6.92	43.24	48.00	690
691	U. S. Chemical Co.'s National Complete..........		0.10	1.77	1.87	1.64	4.54	3.75	3.08	11.37	11.00	8.29	10.00	1.98	2.00	3.64	27.79	30.00	691

COMPLETE FERTILIZERS.

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station Number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station Number.
704	Farmer's Friend	Read & Co., New York.	L. D. Cook, Bound Brook.	704
706	Azotized Bone Superphosphate	Coe & Richmond, Mantua Point.	H. I. Budd, Mount Holly.	706
708	Excelsior	" " " "	" " " "	708
711	Ammoniated Bone Superphosphate	" " " "	" " " "	711
712	High Grade Manure	J. C. Gaskill, Birmingham.	" " " "	712
713	Popular Phosphate	" " "	" " " "	713
715	Special Fish Manure	" " "	" " " "	715
714	Dried and Ground Fish Guano	H. Preston & Sons, Greenpoint.	" " " "	714
716	Quaker City Phosphate	J. J. Allen's Sons, Philadelphia.	" " " "	716
717	Ten per cent. Guano	" " " "	" " " "	717
718	Nitro Phosphate	" " " "	" " " "	718
719	Marine Guano	" " " "	" " " "	719
720	Dried and Ground Fish	" " " "	" " " "	720
721	Popular Phosphate	" " " "	" " " "	721
728	Complete Fertilizer	John Taylor, Trenton.	David C. Voorhees, Blawenburgh.	728
730	U. S. Phosphate, or Royal Bone	Williams, Clark & Co., New York.	" " "	730

COMPLETE FERTILIZERS.

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station Number.		Nitrogen.					Phosphoric Acid.							Potash.					
												Available.							
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phos. Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Chlorine.	Value of 2,000 lbs. at Station's Prices.	Selling Price of 2,000 lbs. at Factory.	Station Number.
704	Read & Co.'s Farmers' Friend		1.78	0.65	2.43	1.85	6.56	1.38	2.53	10.50		7.94	9.00	2.80	1.00	2.92	30.71	32.00	704
706	Coe & Richmond's Azotized Bone Superphos.		0.10	1.18	1.28	0.82	6.47	1.54	3.20	11.21	10.00	8.01	8.00	1.63	1.10	2.83	25.14		706
708	" " Excelsior		0.81	2.70	3.51	3.28	9.38	0.72	0.70	10.80	11.00	10.10	10.00	3.94	2.70	3.42	38.39		708
711	" " Ammon. Bone Superphos.			2.04	2.04	2.05	6.82	1.69	4.03	12.54	12.00	8.51	9.00	1.86	1.10	1.98	30.05		711
712	Gaskill's High Grade Fertilizer		0.85	2.57	3.42	3.28	8.00	0.78	2.05	10.83	8.00	8.78	6.00	4.98	6.00	4.65	37.50	43.00	712
713	" Popular Phosphate			1.91	1.91	1.64	7.30	1.88	3.24	12.42	8.00	9.18	7.00	2.05	2.00	2.32	30.28	33.00	713
715	" Special Fish Manure			1.67	1.67	2.46	2.66	3.67	2.71	9.04	8.00	6.33	6.00	4.37	4.00	9.33	24.77	33.00	715
714	Dried and Ground Fish Guano	0.40	1.13	2.66	4.19	4.12	2.71	2.99	0.90	6.60	5.00	5.70		0.81		1.51	29.35	33.00	714
716	Allen's Quaker City Phosphate		0.13	0.47	0.60	0.41	4.19	3.01	8.93	16.13	16.00	7.20	11.00	1.39	2.00	1.28	25.47		716
717	" 10 per cent. Guano		5.20	3.65	8.85	8.20	4.06	0.93	2.17	7.16		4.99	4.00	3.08	2.00	2.77	51.84		717
718	" Nitro Phosphate		0.74	1.20	1.94	1.64	5.60	2.92	6.17	14.69	11.20	8.52	9.00	2.32	1.00	2.18	32.04		718
719	" Marine Guano		2.13	1.74	3.87	3.28	6.56	2.03	3.49	12.08		8.59	6.00	2.94	2.50	2.60	38.75		719
720	" Dried and Ground Fish Guano		0.64	1.26	1.90	2.05	8.20	3.38	4.71	11.29		6.58	6.00	2.77	2.50	4.98	26.93		720
721	" Popular Phosphate		0.92	0.92	1.84	0.62	3.23	3.92	5.11	12.26		7.15	6.00	2.47	2.50	4.14	27.95		721
728	Taylor's Complete Fertilizer for Corn		0.80	1.41	2.21	2.79	2.40	4.21	6.24	12.85	13.28	6.61		5.17	5.00	4.83	31.55	34.00	728
730	Williams, Clark & Co.'s U. S. Brand Royal Bone			0.89	0.89	0.82	3.81	2.54	1.43	7.78	7.00	6.35	6.00	2.41	2.00	1.99	19.09	22.50	730

COMPLETE FERTILIZERS.

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station Number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station Number.
702	National Potato Fertilizer..................................	U. S. Chemical Co., Camden.	H. I. Budd, Mount Holly.	702
735	Taylor & Co.'s Wheat Fertilizer, Brand B...........	John Taylor & Co., Trenton.	Assistant Chemist of Station.	735
786	" " " " Brand A...........	" " " "	Chemist of Station.	786
753	H. J. Baker & Brother, Oat and Rye Manure.....	H. J. Baker & Brother, New York.	" "	753
754	A. A. Ammoniated..	" " " "	"	754
797	Good Enough..	M. L. Shoemaker & Co., Philadelphia.	" "	797
800	Echo..	" " " "	" "	800
802	Soluble Pacific Guano...	Soluble Pacific Guano Co., Boston.	David C. Voorhees, Blawenburgh.	802
810	Waddington Phosphate..	Joseph Waddington & Son, Salem.	Joshua Waddington, Salem.	810
811	Ashes, Wool Waste, &c.......................................	James Tully, Philadelphia.	F. C. Lippincott, Marlton.	811
813	Mitchell's Standard Phosphate............................	A. Mitchell, Linden, N. J.	J. E. Bennett, Cranbury.	813
814	Ashes..		J. A. Woodruff and F. Bohl, Bridgeton.	814

COMPLETE FERTILIZERS.

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station Number.		Nitrogen.					Phosphoric Acid.							Potash.					
												Available.							
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Found.	Total Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Found.	Total Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Chlorine.	Valuation of 2000 lbs. at Station's Prices.	Selling Price at Factories.	Station Number.
702	National Potato Fertilizer			1.26	1.26	1.64	2.91	4.34	3.07	10.32		7.25	8.00	2.17	3.00	4.01	23.28		702
735	Taylor & Co.'s Wheat Fertilizer Brand B		1.13	1.92	3.05	2.88	1.31	2.68	5.77	9.76	10.00	3.99		2.42	2.50	2.35	27.33	27.00	735
736	" " " " " A			3.90	3.90	3.32	3.60	3.90	5.12	12.62		7.50	7.31	3.23	2.50	2.98	37.67	33.00	736
753	H. J. Baker & Bro., Oat and Rye Manure		3.36	1.02	4.38	4.11	4.06	1.32	0.41	5.79		5.38	5.00	10.25	9.00	8.10	38.44		753
754	" " " A. A. Ammoniated		1.19	1.13	2.32	2.46	8.67	0.83	0.64	10.14		9.50	10.00	2.66	2.00	4.28	31.40		754
797	M. L. Shoemaker & Co.'s Good Enough	0.18	0.13	1.38	1.69	1.24	7.68	2.36	3.58	13.62	12.00	10.04	8.00	2.73	3.00	2.33	31.89	35.00	797
800	" " " Echo			1.22	1.22	0.82	4.86	2.29	4.60	11.75	9.00	7.15	7.00	1.94	2.00	3.82	24.51	26.00	800
802	Soluble Pacific Guano		0.14	2.23	2.37	2.51	6.78	1.20	5.90	13.88	12.00	7.98	8.95	1.17	2.60	1.05	30.96		802
810	Waddington's Phosphate			0.59	0.59	0.82	3.71	2.22	4.33	10.26		5.93	6.00	2.27	1.50	4.90	19.61	25.00	810
811	Ashes, Wool Waste, etc.			0.84	0.84				0.54	0.54				0.50		0.50			811
813	Mitchell's Standard Phosphate		1.00	1.42	2.42	1.64	6.59	1.50	2.05	10.14	8.00	8.09		1.10	2.00	1.83	28.75	36.00	813
814	Ashes			0.56	0.56				0.54	0.54				0.41		0.52			814

DISSOLVED BONES

AND

NITROGENOUS SUPERPHOSPHATES.

Furnishing Nitrogen and Available Phosphoric Acid.

Station Number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station Number.
613	Dissolved Bones	Harrison Bros., Philadelphia.	Chas. Collins, Fellowship.	613
626	$25 Phosphate	Baugh & Son, “	I. W. Nicholson, Camden.	626
679	Dissolved Bones	“ “ “	H. I. Budd, Mount Holly.	679
685	Raw Bone Superphosphate.	“ “ “	“ “ “ “	685
709	Doughtens' Am. Bone Superphosphate	Preston & Son, Greenpoint.	“ “ “ “	709
796	Dissolved Bones	M. L. Shoemaker & Co., Philadelphia.	Chemist of Station.	796
808	Ammoniated Dissolved Bones	“ “ “ “	David C. Voorhees, Blawenburgh.	808
808	“ Phosphate	Elizabethport Glue Works.	“ “ “ “	808

DISSOLVED BONES

AND

NITROGENOUS SUPERPHOSPHATES.

ANALYSIS AND VALUATIONS.

Station Number.	BRAND.	Nitrogen.			Phosphoric Acid.			Estimated Value,	Station Number.
		From Ammonia Salts.	From Organic Matter.	Total Nitrogen.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.		
613	Harrison Bros., Dissolved Bones		2.27	2.27	7.42	4.60	4.13	$35.92	613
626	Baugh & Sons, $25 Phosphate	0.31	1.27	1.58	2.51	1.45	6.59	20.00	626
679	" " Dissolved Bones		2.31	2.31	3.74	5.63	2.96	29.51	679
685	" " Raw Bone Superphosphate	0.25	1.42	1.67	3.87	2.17	8.32	25.92	685
709	Doughtens' Ammoniated Bone Superphosphate	0.34	2.08	2.42	7.46	1.40	3.02	29.98	709
796	Shoemaker & Co.'s Swift Sure Dissolved Bone		2.94	2.94	10.14	2.68	5.43	41.75	796
803	" " Ammoniated Dissolved Bone		1.61	1.61	5.31	3.02	5.70	27.63	803
808	Elizabethport Glue Works' Ammoniated Superphosphate		0.76	0.76	8.64	1.87	3.08	26.31	808

GROUND BONE.

Furnishing Nitrogen and Insoluble Phosphoric Acid.

Station Number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station Number.
605	Peter Cooper's Coarse Bone	Peter Cooper Glue Co., New York.	Assistant Chemist of Station.	605
621	Ground Bone	John I. Smith, Trenton.	J. V. D. Christopher, New Brunswick.	621
631	Button Bone	L. Moritz, Philadelphia.	I. W. Nicholson, Camden.	631
632	Never Failing Bone	Berg (?) "	" " "	632
655	Cooper's Pure Bone	Peter Cooper Glue Co., New York.	J. V. D. Christopher, New Brunswick.	655
659	Ground Bone	B. Ruckman, Adams Station.	Arnold Farmer, " "	659
665	Pure Ground Bone	Terry Clancy, New Brunswick.	J. V. D. Christopher, " "	665
666	Crescent Bone	Lister Bros., Newark.	" " " "	666
683	Strictly Pure Raw Bone	Baugh & Sons, Philadelphia.	H. I. Budd, Mount Holly.	683
684	Export Bone	" " "	" " " "	684
710	Pure Bone Sawings	H. Preston & Sons, Greenpoint, L. I.	" " " "	710
734	Pure Ground Bone	B. Ruckman, Adams Station, N. J.	A. DeHart Voorhees, New Brunswick.	734
742	Ground Bone	Geo. B. Forrester, New York.	Chemist of Station.	742
759	Pure Ground Bone	Lister Bros., Newark.	" " "	759
794	Swift Sure Bone Meal	M. L. Shoemaker & Co., Philadelphia.	" " "	794
795	" " Ground Bone	" " " "	" " "	795
809	Mapes' Pure Ground Bone	Mapes' F. and P. Guano Co., New York.	David C. Voorhees, Blawenburgh.	809

GROUND BONE.

Furnishing Nitrogen and Insoluble Phosphoric Acid

Station Prices.	MANUFACTURER.	Mechanical Analysis.					Chemical Analysis.		Value of 2,000 lbs. at Station's Prices.	Selling Price of 2,000 lbs.	Station Number.
		Finer than 1-50 inch.	Finer than 1-25 inch.	Finer than 1-12 inch.	Finer than 1-6 inch.	Coarser than 1-6 inch.	Nitrogen.	Phosphoric Acid.			
605	Peter Cooper Glue Co.	16	12	14	10.	.48	2.02	12.10	$16.63	$15.00	605
621	John I. Smith	27	29	30	14	.00	4.85	20.00	36.28	40.00	621
631	L. Moritz	9	21	39.5	28	2.50	4.35	23.88	36.31	38.00	631
632	Berg (?)	21	32	24.5	22	0.5	3.31	18.64	29.52	38.00	632
655	Peter Cooper Glue Co.	46	16	11	13	14.	2.38	26.55	35.63	31.00	655
659	B. Ruckman	6.5	17	22	43.5	11	4.07	21.86	31.90	40.00	659
665	Terry Clancy	11.5	13	18	37.5	20	3.80	23.30	33.34	40.00	665
666	Lister Bros.' Crescent Bone	24	24	19.5	24.	8.50	2.91	13.67	22.61	30.00	666
683	Baugh & Sons	24	46	30	00	00	3.70	21.68	35.47	36.00	683
684	" "	48	44	8	00	00	2.42	14.64	24.83	31.00	684
710	H. Preston & Sons	46	38	10	6	00	3.76	25.63	41.19	42.00	710
734	B. Ruckman	15	28	23	26	8	4.00	17.97	29.71	40.00	734
742	Geo. B. Forrester	42	43	15	00	00	3.72	21.84	36.92		742
759	Lister Bros.	15.5	27	25	26.5	6	3.24	23.50	33.29		759
794	M. L. Shoemaker & Co.	54	36.5	9.5	00	00	6.36	19.89	44.25	40.00	794
795	" " "	47.5	27	13.5	11.5	0.5	5.99	21.15	42.86	39.00	795
809	Mapes' F. and P. Guano Co.	34.5	46	19.5	00	00	1.27	30.36	37.99	39.00	809

ASHES.

Station No.	BRAND.	MANUFACTURER.	SAMPLED BY
604	Spent Hemlock Bark Ashes.	Hoyt Bros., Blossburgh, Pa.	Geo. H. Cook.
606	Canada Ashes		Van Buren Giffen, Kirkwood, N. J.
609	" "	Monroe, Judson & Stroup, Oswego.	J. T. Lovett, Little Silver, N. J.
646	Wood Ashes	Sayre & VanDerhoof, Hamburg.	W. A. Stiles, Deckertown, N. J.
650	" "	J. Urnstone, Rahway.	B. C. Whitney, Rahway, N. J.
733	Bog Ashes		Lewis D. Cary, Flanders, N. J.
801	Wood Ashes	J. A. Emmons & Co., Kirkwood, N. J.	Lewis D. Cook, Bound Brook, N. J.

Station Number.		Percentage.		
		Phosphoric Acid.	Potash.	Lime.
604	Leached Wood Ashes	1.88	1.89	33.92
606	Unleached " "	1.17	8.72	36.80
609	" " "	2.02	5.87	43.60
646	Leached " "	0.95	1.85	49.68
650		1.10	0.64	14.20
733	Bog Ashes	0.87		
801	Leached Wood Ashes	1.10	0.66	29.60

MISCELLANEOUS SAMPLES.

No. 656. Florida Phosphate; from the Florida Phosphate Company, Hawthorne, Florida. Cost at Hawthorne, Florida, $18.50 per ton. Contains total phosphoric acid, 15.18 per cent., and 37.87 per cent. insoluble matter. Sampled by H. W. Butterworth, Morristown, N. J.

No. 668. No. II Orchilla Guano, A. A. Imported by R. A. Wooldridge & Co., Baltimore, Md. Contains 5.44 per cent. reverted phosphoric acid, 10.38 insoluble; total, 15.82 per cent. Sampled by H. I. Budd, Mt. Holly, N. J.

No. 723. Hair Waste, from Ayers' Mills, Blackwood, N. J. Contains 6.44 per cent. organic nitrogen. Sampled by George B. Hurff, Hurffville, N. J.

No. 724. Wool Waste, from Ayers' Mills, Blackwood, N. J. Contains 7.96 per cent. organic nitrogen. Sampled by George B. Hurff, Hurffville, N. J.

FERTILIZERS.

II.

AGRICULTURAL RELATIONS.

The necessity of explaining the difference between the commercial and agricultural value of a fertilizer is still apparent.

Thus far in this Report the commercial relations only have been considered. These embrace statistics of sales, wholesale and retail market prices, questions as to guaranteed composition of fertilizing mixtures, and comparisons between brands from various manufacturers. Information concerning these points can be obtained either in the merchant's counting-house, the broker's office, or the chemist's laboratory.

The agricultural value of a fertilizer, or the profit which its use secures for a farmer in an increased crop, is in no way indicated by its market price. Nitrogen and phosphoric acid, the two most costly elements of plant food, often enough are used at a positive loss; while potash, commercially considered the cheapest element, very often is found to be agriculturally the most valuable.

From the commercial value, therefore, no positive conclusions as to agricultural values can be drawn.

Reliable information concerning agricultural values must be sought upon the farm, not from the guesses of the farmer only, but from the actual weights of the crops, grown under known conditions upon accurately measured areas.

When it was definitely settled that plants invariably removed certain elements from the soil, and certain other elements from the air, further that these "air" elements were always present and available, the conclusion was hastily reached that, a chemist by analysis alone, could, without seeing or knowing anything about a field, state positively which crop would flourish upon it, or what element must be added to render it fertile.

Experience has shown the fallacy of this reasoning, and to-day no agricultural chemist would guarantee an average crop, even if his own analysis of an absolutely fair sample of the soil, made him positive that the field contained twenty times more plant food than any harvest could possibly remove.

The difficulties in determining what a field actually requires has led men to reason that they run less risk of failure if they mix together every thing known to be valuable, and give the plant an opportunity of selecting what it can utilize. The so-called complete fertilizers are made upon this plan. This is as rational as it would be for a manufacturer, knowing what materials are used in making a wagon, to at once buy what was needed without first examining his store-house to find what he already had in stock; his course, in fact, would be less open to criticism, for his stock might improve by storage, a fact unfortunately not the case with the farmer, whose most costly supply, nitrogen, is known to waste rapidly under certain conditions present upon each fertile field.

With increased experience it has become evident that, as a broad general rule, an excess of one element on a certain crop, for instance, nitrogen on wheat, gives the largest and most profitable return.

This has led to the mixing of so-called special fertilizers, advertised by manufacturers to be specially suited for a certain crop.

This plan, because it, too, ignores the stock already in the soil of a given field, is also irrational and wasteful, particularly as farmers under the impression that such materials are especially suited for their purpose, have certainly in the past paid 20 per cent. more than market prices for the plant food in "special" brands.

Prof. Atwater, referring to this point, writes: "As long as soils and seasons continue to differ, then formulas to fit all cases are simply out of the question; at the same time, there are many cases in which a man does not know what the soil requires, and can better afford to use a complete fertilizer and pay the penalty of his ignorance in the purchase of superfluous material, than to run the risk of losing his crop. *Formulas are irrational, but they mark the first step in the progress towards rational fertilization.*"

Fertilizer manufacturers and farmers are both interested in ascertaining what is needed and what is rational.

Often station officials hear brands of fertilizers pronounced worthless, by farmers who have used them without the least benefit. Frequently such criticisms inferring dishonesty upon the dealer's part, are known at the Station to be in a measure groundless; the mixture containing all that the maker claims in his guarantee; the dealer's dishonesty resting entirely in his statement as to what his mixture could do. It is difficult to convince a farmer in such a case that a dealer cannot know what element or combination of elements are necessary for his farm; it is equally difficult to convince a manufacturer that a too general advertisement, by claiming more than, can be fulfilled, will eventually bring him to grief. At present there seems to be one remedy only for this trouble, and that is for each farmer to test his own lands and find what elements of plant food will give him most favorable returns.

The method is simple and can be carried out by any thoughtful man; a piece of land measuring one and one-tenth acres is divided into eleven plots. Two of the plots are planted without fertilizers or manure of any kind, these will indicate what the land alone can yield. Upon the remaining nine plots, materials containing plant food are applied broadcast. On plots 2, 3 and 4, single elements on each; on plots 5, 7 and 8 combinations of two elements upon each; plot 9, all three elements, and upon plot 11 barn yard manure.

By measuring or weighing the crop from each plot separately, the benefit of each costly ingredient found in a complete fertilizer can be determined, and strong reasons thereby given the farmer, either for purchasing or declining to purchase any particular element.

Nearly thirty of these trials have been made in this State, under the Station's directions during the past four years; illustrations of their value can now be presented.

In 1883 Mr. John Voorhees, of South Branch, began with his experimental plots; his first crop was corn. The results indicated in a positive manner that upon this crop potash would return a large profit upon the investment.

Governed by these indications, Mr. Voorhees, in 1884, made the investment, and also made money by so doing.

A ton of the muriate costing $40 was broadcasted upon thirteen acres of corn ground. To test results, four acres dressed with the muriate, and one acre without fertilizers, were set off from the rest and the product gathered separately.

The gain from the use of the potash was thirty bushels of ears per acre, worth $7.50.

This involved an outlay of $3 for the fertilizer, leaving $4.50 to represent the profit following its use. The crop from the rest of the field satisfied Mr. Voorhees that it was equally favorable.

An outlay of $40 for muriate of potash, therefore, returned $97.50, a net profit of $57.50 exclusive of that existing in the largely increased yield of stalks.

Mr. S. C. Dayton, of Basking Ridge, has been studying his trap rock soil for the past four years. His experiments have included two crops of corn, and one each of oats and clover.

The indications in every experiment have been the same; superphosphates used alone irrespective of crop or season, have invariably increased the yield.

The details given below show that the first corn crop planted in 1881 was a failure caused by drought, but even here the effects of the phosphoric acid are evident.

Stephen C. Dayton,—Trap Rock Soil.

Plot.	1	2	3	4	5	6	7	8	9	10	11
Kind.	Nothing.	Nitrate of Soda.	Superphosphate.	Muriate of Potash.	Nitrate of Soda. Superphosphate.	Nothing.	Nitrate of Soda. Muriate of Potash.	Superphosphate. Muriate of Potash.	Nitrate of Soda. Superphosphate. Muriate of Potash.	Plaster.	Fine Barn Yard Manure
Weight per Acre.		350	350	150	150 350		150 150	350 140	150 350 150	400	20 Two Horse Loads.
Crop.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.
Corn	5	5.3	10.1	6.3	12.8	4.9	6.3	16.3	19.4	5.8	13.4
Corn	41.3	45.4	60.7	44.6	63.4	44.2	43.1	63.2	67.5	54.4	76.3
Oats	20	22.3	45.6	18.6	57.6	15.0	20.3	44.0	60.0	18.3	58.6
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Clover	990	1060	5700	1140	5900	980	1330	8500	8800	1220	9200

With corn and oats a fair profit, in each case, followed the use of phosphoric acid. Combinations of this element with nitrogen as well as with potash slightly increased the crop yield, but at such an expense that the additional cost was not covered.

On the clover crop only was the increase from combinations of plant food large enough to admit of financial profits.

This series of experiments warns Mr. Dayton to be exceedingly careful in his use of *special* fertilizers, since his farm apparently forms a striking exception to the rule that corn answers best to applications of potash and cereals to nitrogen.

Rev. Henry P. Thompson has also carried out three careful experiments in rotation upon his farm near Readington.

The second experiment upon potatoes was, for some unknown reason, a failure; the first and third upon corn and wheat respectively are, however, quite as instructive as Mr. Dayton's.

Rev. Henry P. Thompson,—Red Shale Soil.

Plot.	1	2	3	4	5	6	7	8	9	10	11
Kind.	Nothing.	Nitrate of Soda.	Superphosphate.	Muriate of Potash.	Nitrate of Soda. Superphosphate.	Nothing.	Nitrate of Soda. Muriate of Potash.	Superphosphate. Muriate of Potash.	Nitrate of Soda. Superphosphate. Nitrate of Soda.	Plaster.	Fine Barn Yard Manure.
Weight per Acre.		150	350	150	150 350		150 150	350 150	150 350 150	400	20 Two Horse Loads.
Crop.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.
Corn	19.7	30.	42.	43.2	49.	36.	44.	55.	47.2	21.6	38.5
Wheat	12.5	14.5	33.	12.0	33.3	10.6	12.02	36.2	41.	10.3	46.6

Contrary to expectation, but still in close agreement with Mr. Dayton's results, the corn yield increases with the use of phosphoric acid, the largest increase resulting from its combination with potash; owing, however, to very noticeable differences in the yield from the unmanured plots, no calculations of financial benefit can be safely drawn.

In case of Mr. Thompson's wheat, however, results are positive, and in accord with Mr. Dayton's, both in showing profitable increase from the use of phosphoric acid, and in failing to indicate any advantage from the use of nitrogen upon a cereal crop.

This result warns Mr. Thompson, also, that his farm is probably an exception to the rules upon which special formulas are based.

Mr. Arnold, of Vineland, and Mr. Dalrymple, of Hopewell, have also furnished striking reports.

Nitrogen in both of these experiments proved profitable upon corn; noticeable exceptions to generally entertained opinions.

Many other examples of the need of more of these experiments, and of the immediate financial profit to those making them, might be selected; enough, however, have been given to indicate the line of work in this direction, and to warrant individual farmers and farmers' clubs in taking this question into serious consideration.

FIELD EXPERIMENTS WITH FERTILIZERS ON CORN.

By Mr. N. S. Sergent, Schooley's Mountain, Morris County, N. J.

	FERTILIZERS.			YIELD PER ACRE.		
Number of Plot.	Kind.	Weight per Acre.	Cost per acre.	Pounds of Ears.	Bushels of Shelled Corn.	Pounds of Stalks
1	Nothing			3130	43.5	2010
2	Nitrate of Soda	150 lbs.	$ 4.05	3670	51.0	2620
3	Superphosphate	350 "	5.25	3920	54.4	2740
4	Muriate of Potash	150 "	3.19	4180	58.1	3040
5	Nitrate of Soda Superphosphate	150 350 "	9.30	4330	60.1	3310
6	Nothing			3890	54.0	2720
7	Nitrate of Soda Muriate of Potash	150 150 "	7.24	4500	62.5	3070
8	Superphosphate Muriate of Potash	350 150 "	8.44	4950	68.8	3320
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 " 150	12.49	4480	62.2	2910
10	Plaster	400 "	1.50	4380	60.8	2840
11	Fine Barnyard Manure.	20 2-horse loads	30.00	4620	64.2	3350

Mr. Sergent's experiment made upon the gneissic soil of Schooley's Mountain, is the first in the series upon this farm.

The corn was planted May 12th; cultivated between June 6th and July 4th; harvested September 20th, and husked and weighed November 3d.

The plants upon plots 4 and 5 are reported by Mr. Sergent to have been at first yellow and unpromising, while those upon plots 7, 8 and 9, from the first, were green in color and very rank in growth. In the harvest, however, the differences were not noticeable.

Muriate of Potash, both alone and in combination, has had a noticeable effect both upon grain and stalks, the most profitable yield, however, was obtained from the least costly material, *the plaster*—four hundred pounds of which, very closely approximating the yield from barnyard manure, and exceeded that from muriate of potash.

A possible explanation of this yield is, that plaster has the power of decomposing certain compounds, *rich in potash*, which are believed to be abundant in gneissic soils.

As a bone black superphosphate contains 50 per cent. of plaster, this would also account for the action of the superphosphate upon plots 3, 5, 8 and 9. In effect, therefore the action of the plastér upon suitable soils, should correspond with that of potash salt.

FIELD EXPERIMENTS WITH FERTILIZERS ON CORN.

By Theodore West, College Farm, New Brunswick, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.		
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Ears.	Bushels of Shelled Corn	Pounds of Stalks
1	Nothing	.....	....	4050	56.3	2650
2	Nitrate of Soda	150 lbs.	$ 4.05	5000	69.4	3500
3	Superphosphate	350 "	5.25	3950	54.9	2900
4	Muriate of Potash	150 "	3.19	4500	62.5	3300
5	Nitrate of Soda Superphosphate	150 350 "	9.30	4700	65.2	3300
6	Nothing	.....	....	4800	66.6	3300
7	Nitrate of Soda Muriate of Potash	150 150 "	7.24	5150	71.5	3750
8	Superphosphate Muriate of Potash	350 150 "	8.44	4850	67.4	3750
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 " 150	12.49	4600	63.9	3750
10	Plaster	400 "	1.50	4070	56.5	3400
11	Fine Barnyard Manure	20 2-horse loads	30.00	5670	78.8	4150

For four consecutive years, field experiments upon the above plan have been carried out upon four different sections of this farm.

Financially considered, the first and second crops were failures, due to the severe droughts of 1881 and 1882. Each experiment, however, indicated one point, viz: that potash salts if properly distributed, would not kill corn plants even in excessively dry weather. The first year's work, indeed, indicated from its use a gain of 20 bushels of shelled corn per acre.

In 1883 and 1884, the weather was suitable and the crops were consequently above the average.

Although potash in both cases noticeably and favorably affected the crop, no profits followed its use, the yields from unmanured plots alone, approximating 60 bushels per acre.

This farm of less than one hundred acres is heavily stocked; large quantities of feed are annually bought, and consequently there is an abundance of barnyard manure.

The land for experimental plots is always selected upon sod ground, from which one crop of wheat and two of hay have been taken since the last dressing with barnyard manure and fertilizers. In spite of this fact, however, fertilizers have not been profitable upon corn.

FIELD EXPERIMENTS WITH FERTILIZERS ON CORN.

By Mr. J. W. Dalrymple, Hopewell, Mercer County, N. J.

	FERTILIZERS.			YIELD PER ACRE.			
Number of Plot.	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Ears good.	Pounds of Ears poor.	Bushels of Shelled Corn.	Pounds of Stalks
1	Nothing....................	....	....	3550	1110	49.8	3350
2	Nitrate of Soda............	150 lbs.	$ 4.05	4340	630	60.3	3450
3	Superphosphate..........	350 "	5.25	4200	510	58.8	3400
4	Muriate of Potash......	150 "	3.19	4450	270	61.8	3500
5	Nitrate of Soda............ Superphosphate..	150 350 "	9.30	4900	260	68.0	3550
6	Nothing....................	....	....	3200	1000	44.4	3150
7	Nitrate of Soda............ Muriate of Potash......	150 150 "	7.24	5330	260	74.0	4300
8	Superphosphate.......... Muriate of Potash......	350 150 "	8.44	5050	210	70.1	4000
9	Nitrate of Soda .... Superphosphate.......... Muriate of Potash	150 350 " 150	12.49	5000	230	69.4	3940
10	Plaster..........................	400 "	1.50	3150	1280	43.8	3000
11	Fine Barnyard Manure	20 2-horse loads	30.00	4200	560	58.3	3350

This is the first experiment in the rotation upon this farm.

The soil is a fine red shale, well suited for corn, wheat and oats.

Early dent seed was planted May 16th; the crop was cut September 27th, and husked and weighed October 27th.

May 29th a heavy frost "nipped" the corn and killed the leaves; June 9th, plot 2, upon which nitrate of soda was used, indicated the healthiest growth, plots 7 and 11 standing next in order. On July 12th, plots 2 and 11 apparently surpassed the others; at harvest, however, five other plots throughout the season inferior in appearance, surpassed plots 2 and 11 in yield, both of grain and stalks.

All fertilizing ingredients have marked effects upon the crop.

Potash and its combinations being relatively cheaper, give largest profits.

The increased yield from plot 9, fails to cover the cost of the plant food.

Plaster upon this soil has no effect.

FIELD EXPERIMENTS WITH FERTILIZERS ON CORN.

By A. P. Arnold. Vineland, Cumberland County, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.			
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Ears good.	Pounds of Ears poor.	Bushels of Shelled Corn.	Pounds of Stalks.
1	Nothing			2200	180	30.5	2140
2	Nitrate of Soda	150 lbs.	$4.05	2900	140	40.3	2720
3	Superphosphate	400 "		2600	180	36.1	2480
4	Muriate of Potash	150 "	3.19	2620	140	36.4	2680
5	Nitrate of Soda Superphosphate	150 400 "		2660	180	36.9	2600
6	Nitrate of Soda	200 "	5.40	2100	160	29.2	1800
7	Nitrate of Soda	400 "	10.80	2620	220	36.4	2560
8	Superphosphate Muriate of Potash	400 150 "		2800	140	38.9	2660
9	Nitrate of Soda Superphosphate Muriate of Potash	150 400 " 150		2460	140	34.2	2540
10	Plaster			2580	140	35.8	2660

Previous experiments caused Mr. Arnold to feel confident that *Nitrogen* above all things benefitted corn grown upon his light, loamy soil at Vineland.

The above experiment was planned to again test this point, as well as to study the question as to the quantity of nitrogen from which most profit could be made.

This field in 1882 produced a fair crop of clover; its soil is regarded as particularly suited for sweet potatoes, clover, and berries of all kinds.

The season was very unfavorable; altogether too dry for this land.

Nitrate of soda at the rate of one hundred and fifty pounds per acre increased the yield by ten bushels, showing at fifty cents per bushel a very slight profit, not exceeding one dollar per acre.

Used in larger quantities its effect was not favorable; the yield was lighter, and the quantity of soft corn very much increased.

The decreased yield upon plot 6, dressed with two hundred pounds of nitrate per acre, is believed to have been due to a "middle furrow" upon which the corn was very poor.

FIELD EXPERIMENTS WITH FERTILIZERS ON CORN.

By Stephen C. Dayton, Baskingridge, Somerset County, N. J.

	FERTILIZERS.			YIELD PER ACRE.		
Number of Plot.	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Ears	Bushels of Shelled Corn.	Pounds of Stalks
1	Nothing…………………	…………………	…………	2890	41.3	1670
2	Nitrate of Soda………………	150 lbs.	$ 4.05	3180	45.4	1900
3	Superphosphate…………	350 "	5.25	4250	60.7	2300
4	Muriate of Potash……	150 "	3.19	3120	44.6	1950
5	Nitrate of Soda………… Muriate of Potash……	150 350 "	9.30	4440	63.4	2460
6	Nothing…………………	…………………	…………	3100	44.2	1930
7	Nitrate of Soda………… Muriate of Potash……	150 150 "	7.24	3015	43.1	1990
8	Superphosphate………… Muriate of Potash……	350 150 "	8.44	4430	63.2	2630
9	Nitrate of Soda………… Superphosphate………… Muriate of Potash……	150 350 " 150	12.49	4725	67.5	2620
10	Plaster…………………	400 "	1.50	3810	54.4	2060
11	Fine Barnyard Manure	20 2-horse loads	30.00	5345	76.3	3380
12	Fine Barnyard Manure Slaked Lime……………	10 do. 50 bu.	20.00	4485	64.1	2780

Mr. Dayton has made several experiments upon the trap rock soil of his farm, with the results already noted in detail in the introduction to this chapter.

The above experiment upon corn is the first in a new series.

The field had been for two previous years in grass; it was planted April 24, 1884, with peach trees; thirteen per plot or one hundred and thirty per acre. May 16th, corn was planted in the usual manner, cultivated the first time with a plow, then hand hoed, and later cultivated level and shallow with a horse cultivator. The weather at first was unfavorable, but at the close of the season it improved very much. The corn ripened sound and dry, and shelled readily; seventy pounds of ears giving fifty-six pounds of shelled corn.

The crop was cut and stacked September 24th, and husked and weighed October 20th.

The noticeable points in the experiment are: the very positive and favorable effects of the superphosphates when used either alone or in combinations; the almost entire absence of any increase from either nitrate of soda or muriate of potash; and the large and profitable crop from the plot dressed with plaster.

The increase upon plot 10 may indicate that this soil contains zeolite or insoluble combinations of potash, which plaster is able to decompose and make available for plant food. If this is so, the failure of the muriate of potash to affect the crop is difficult to explain. If this explanation of the effects of plaster is admitted, a considerable proportion of the increase from the superphosphate plots must be also credited to plaster, of which bone black superphosphate contains nearly 50 per cent. Allowing the full effect of the plaster in the superphosphate, there still remains, however, an increase of thirteen bushels upon plot 3, due to the phosphoric acid.

Practically, the fact remains the same, whatever the explanation, that superphosphate upon this soil produced a net profit of $3.75 per acre.

FIELD EXPERIMENTS WITH FERTILIZERS ON OATS.

By Theodore West, College Farm. New Brunswick, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.			Pounds per Measured Bushel.
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Oats.	Bushels of Oats.	Pounds of Straw.	
1	Nothing	....	....	1260	42.0	1540	31.00
2	Nitrate of Soda.........	150 lbs.	$ 4.05	1490	49.6	2210	31.00
3	Superphosphate	350 “	5.25	1340	44.7	1560	30.50
4	Muriate of Potash.......	150 “	3.19	1420	47.3	1580	32.25
5	Nitrate of Soda........... Superphosphate..........	150 350 “	9.30	2000	66.7	2400	32.50
6	Nothing	....	....	1820	60.7	1880	32.00
7	Nitrate of Soda.. .... Muriate of Potash.......	150 150 “	7.24	2140	71.3	2610	32.25
8	Superphosphate .... Muriate of Potash.......	350 150 “	8.44	1960	65.3	2140	32.50
9	Nitrate of Soda........... Superphosphate.......... Muriate of Potash.......	150 350 “ 150	12.49	2145	71.5	2525	32.50
10	Plaster	400 “	1.50	1795	59.8	2160	30.25
11	Fine Barnyard Manure.	20 2-horse loads	30.00	1985	66.2	2720	32.50

This experiment is the second in a new series begun last season, upon the above plots, planted in corn and then fertilized with the same quantities and mixtures of materials, as were used this year upon oats.

Neither nitrate of soda, muriate of potash nor superphosphate used alone increased the yield enough to pay the cost of material.

Plot 6, upon which no fertilizers had been used for at least four years, indicates an enormous increase over Plot 1, for which no explanation can at present be offered.

As this plot clearly does not represent the unmanured soil of the field, it is ignored in the comparisons, as to the effect of the fertilizers.

The most profitable results follow the use of plaster; an increase of nearly eighteen bushels per acre, at thirty cents per bushel, amounting to an income of $5.40 from an investment of $1.50.

In a former experiment upon oats in 1882 similar results were obtained, but as the season was much less favorable than that of 1884, the profits then were smaller.

The combination of nitrate of soda and muriate of potash upon Plot 7, gave seventy-one and three-tenths bushels of thirty-two and one-quarter pounds each, a net gain of thirty bushels per acre; the cost of material, however, limited the profits to $1.75 upon an investment of $7.25.

In all other cases, notwithstanding the very heavy crops, fertilizers were either used at a loss, or including the increased weight of straw, barely returned the amount invested.

FIELD EXPERIMENTS WITH FERTILIZERS ON OATS.

By Mr. John Voorhees, South Branch, Somerset Co., N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.			
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Oats.	Bushels of Oats.	Pounds of Straw.	Weight per Measured Bushel
1	Nothing........................	....	....	1320	44.0	1810	24.5
2	Nitrate of Soda..........	150 lbs.	$4 05	1420	47.3	1475	28.3
3	Superphosphate..........	350 "	5 25	1320	44.0	1410	28.0
4	Muriate of Potash.......	150 "	3 19	1350	45.0	1280	29.0
5	Nitrate of Soda.......... Superphosphate..........	150 " 350 "	9 30	1630	54.3	2090	28.0
6	Nothing........................	....	....	1100	37.0	1240	27.0
7	Nitrate of Soda.......... Muriate of Potash......	150 " 150 "	7 24	1480	49.3	1580	28.3
8	Superphosphate.......... Muriate of Potash.......	350 " 150 "	8 44	1620	54.0	1515	30.3
9	Nitrate of Soda.......... Superphosphate.......... Muriate of Potash.......	150 " 350 " 150 "	12 49	1590	53.0	1775	29.5
10	Plaster......................	400 "	1 50	1070	35.7	1125	28.0
11	Fine Barnyard Manure	20 2-horse loads	30 00	1390	46.3	1640	28.0

Mr. Voorhees' land is termed a clay loam, well adapted with favorable weather for corn, oats and wheat.

His first experiment upon the above plots, with a similar set of fertilizers, was made on corn in 1883.

The results were then positive, indicating a course for fertilizing this crop, which Mr. Voorhees has since followed in growing his corn crop with financial success.

Unfavorable weather for oats throughout the entire season, prevented the action of fertilizers, and rendered the experiment a failure. The spring was backward and planting was delayed until April 22d. May and June were very dry and hot, and the remainder of the season excessively rainy. This caused a second growth which delayed the ripening of the crop.

The weight of a measured bushel indicates that the grain was soaked by rains during the harvest; its bulk was thereby considerably increased, and its quality seriously injured.

FIELD EXPERIMENTS WITH FERTILIZERS ON CLOVER.

By Dr. C. W. Larison, Ringoes, Hunterdon Co., N. J.

Number of Plot.	FERTILIZERS.			Pounds per Acre.
	Kind.	Weight per Acre.	Cost per Acre.	
1	Nothing			2580
2	Nitrate of Soda	150 lbs.	$ 4.05	2580
3	Superphosphate	350 "	5.25	3020
4	Muriate of Potash	150 "	3.19	3900
5	Nitrate of Soda Superphosphate	150 " 350	9.30	3360
6	Nothing			2520
7	Nitrate of Soda Muriate of Potash	150 " 150	7.24	3760
8	Superphosphate Muriate of Potash	350 " 150	8.44	4200
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 " 150	12.49	3960
10	Plaster	400 "	1.50	2740
11	Fine Barnyard Manure	20 2-horse loads.	30.00	5320

Red clover was sown upon these experiment plots in April, 1883.

The fertilizers were applied during the morning of May 1st; a heavy shower fell the afternoon of the same day.

The season throughout was very dry and unfavorable for clover.

Muriate of potash alone increased the yield by over thirteen hundred pounds, at a net profit of $2.00 per acre. This is the only case in which a profit was secured; though increased yields in relatively the same proportion were secured from Plots 7, 8 and 9, upon which potash was used in combination with the other ingredients.

Phosphoric acid, the ruling element in previous years upon the same plots with corn, oats and wheat, produced only a very slight increase.

No perceptible gains were caused upon the field by plaster.

FIELD EXPERIMENTS WITH FERTILIZERS ON WHEAT.

By Rev. Henry P. Thompson, Readington, Hunterdon Co., N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.		
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Wheat.	Bushels of Wheat.	Pounds of Straw.
1	Nothing			750	12.5	1150
2	Nitrate of Soda	150 lbs.	$ 4.05	870	14.5	1300
3	Superphosphate	350 "	5.25	1980	33.0	2750
4	Muriate of Potash.	150 "	3.19	720	12.0	960
5	Nitrate of Soda Superphosphate	150 350 "	9.30	2000	33.3	3050
6	Nothing			640	10.6	910
7	Nitrate of Soda Muriate of Potash	150 150 "	7.24	730	12.2	970
8	Superphosphate Muriate of Potash	350 150 "	8.44	2170	36.2	3280
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 " 150	12.49	2460	41.0	3700
10	Plaster	400 "	1.50	620	10.3	1100
11	Fine Barnyard Manure	20 2-horse loads	30.00	2760	46.0	4130

The following abstract is taken from Mr. Thompson's unusually well-kept notes of the experiment:—

The soil, a heavy clay loam, yields upon the average thirty-five bushels of corn and fifteen of wheat.

In 1878, 1879 and 1880 fair crops of oats, wheat and grass were harvested. In 1881 the experimental plots were staked off and fertilized as in the above experiment.

The first trial was made with corn, and was followed in 1882 under exactly similar conditions with potatoes, and in 1883 with wheat.

Each plot, therefore, has been dressed three times with the experimental sets of fertilizers.

On the 20th of September the fertilizers were spread broadcast; one-half only of the nitrate of soda was used in each case at that time; the balance being reserved to be used as a top-dressing in the spring.

Two bushels of Fultz wheat per acre were drilled September 26th, 1883.

Throughout the fall the weather was favorable, and during the winter the ground was, as a rule, covered with snow.

April 12th, 1884, the balance of the nitrate of soda was applied.

Careful comparisons made at that time indicated that Plot 11 appeared to best advantage, followed by Nos. 9, 8, 5 and 3. No. 2, the nitrated plot, appeared but little better than No. 1, and 10, 4 and 7 also seemed far inferior to 3 and 5.

A second comparison made May 2d, several showers having fallen in the interval, showed the plots relatively the same, except No. 8, which had improved considerably. A month later both 8 and 9 appeared to surpass No. 11.

The wheat was harvested July 5th, threshed and weighed July 17th.

The noticeable effects of the fertilizers are: First, the failure of nitrate of soda to influence the yield, except possibly upon Plot 9, where all plant food existed, doubtless, in excessive quantities.

Second, the persistent and very favorable effect of the superphosphate, when used either alone or in combination.

Third, the noticeably high yield from Plots 11 and 9, forty-six bushels and forty-one bushels per acre; in quality of grain Plot 9 excelled, a measured bushel of its wheat weighing sixty-two pounds, and one from Plot 11 weighing fifty-eight pounds.

The experiment is exceedingly instructive, indicating a probably profitable plan for fertilizing future wheat crops upon this field.

FIELD EXPERIMENTS WITH FERTILIZERS ON CLOVER AND MILLET.

By A. P. Arnold, Vineland, Cumberland Co., N. J.

Number of Plot.	FERTILIZERS.			
	Kind.	Weight per Acre.	Cost per Acre.	Pounds per Acre.
1	Nothing			910
2	Nitrate of Soda	150 lbs.	$ 4.05	2010
3	Superphosphate	350 "	5.25	1060
4	Muriate of Potash	150 "	3.19	1020
5	Nitrate of Soda Superphosphate	150 350 "	9.30	2210
6	Nothing			970
7	Nitrate of Soda Muriate of Potash	150 150 "	7.24	2430
8	Superphosphate Muriate of Potash	350 150 "	8.44	1200
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 " 150	12.49	3280
10	Plaster	400 "	1.50	1070
11	Fine Barnyard Manure	20 2-horse loads.	30.00	3580

This experiment is best explained by abstracts from Mr. Arnold's letter of Aug. 25th, 1884.

He writes in substance as follows :—"In making this report I do not wish it to be understood that a crop of millet was sought as a direct source of profit. Our problem here is to secure a clover sod upon which to grow a corn crop. If clover seed is sown alone, weeds take possession of the ground at first, and make the small amount of clover which is secured by late cutting of comparatively little value.

By sowing millet and clover together I secure fodder, which my stock consume as readily as they do baled hay worth here $20 per ton. My clover, too, is not inferior to that secured by others, who seed down without millet and receive little or no benefit from the first cut, because of weeds.

You will notice that nitrate of soda very favorably influences the millet; its action upon the clover is less favorable, and is surpassed by both potash and phosphoric acid.

The millet and clover mixed were harvested August 18th, and now August 25th, the clover upon Plot 8 is far better than upon any other plot.

Without doubt, the yields given in my record would have been much heavier had the season been favorable.

FIELD EXPERIMENTS WITH FERTILIZERS ON POTATOES.

By Samuel P. Ridgway, Hurffville, Gloucester Co., N. J.

	FERTILIZERS.			YIELD PER ACRE.	
Number of Plot.	Kind.	Weight per Acre.	Cost per Acre.	Pounds.	Bushels.
1	Nothing....	....	....	3170	52.8
2	Nitrate of Soda........................	150 lbs.	$ 4.05	4690	78.2
3	Superphosphate........................	350 "	5.25	4130	68.8
4	Muriate of Potash..................	150 "	3.19	3730	62.2
5	Nitrate of Soda........................ Superphosphate........................	150 350 "	9.30	3650	60.8
6	Nothing..................................	....	....	4900	81.6
7	Nitrate of Soda........................ Muriate of Potash..................	150 150 "	7.24	6480	108.0
8	Superphosphate........................ Muriate of Potash..................	350 150 "	8.44	6160	102.6
9	Nitrate of Soda........................ Superphosphate........ .... Muriate of Potash..................	150 350 " 150	12.49	8760	146.0
10	Plaster..........	400 "	1.50	4430	73.8
11	Fine Barnyard Manure...........	20 2-horse loads.	30.00	5830	97.1

Mr. Ridgway's experiment is the first attempted under the Station's direction in this section of Gloucester Co.

The soil is loamy, with clay and gravel subsoil; it is well adapted to corn, potatoes, wheat and clover.

During the experiment the weather was unfavorable, and much annoyance and loss was caused by the potato bug.

A noticeable difference in yield between the unmanured plots, calls for caution in interpreting the results of this trial.

One point, however, is the great difference in yield between Plots 9 and others adjoining it. It is safe to credit this largely to the complete fertilizer.

SORGHUM.

I. Field Experiments upon the College Farm.
II. History of the Cape May Plantation, and Experiments on the Extraction of Sugar.
III. General Remarks on the Sugar Industry.

I.

FIELD EXPERIMENTS UPON THE COLLEGE FARM.

In order to render the sorghum sugar industry independent of tariff and bounties, improvements in the quality of the cane and increased yields per acre are necessary, as well as economical methods of handling the crop, of extracting its sugar, and of utilizing its waste products.

Quality and quantity depend to a great extent upon conditions which are under the planter's control, viz.: Upon the variety of seed and the time of planting; upon the fertilizers used, the cultivation and the date of harvesting. Experiments bearing upon several of these points have been carried out on the College Farm during the past year.

VARIETY OF SEED.

The length of the season governs the selection of seed. Both Early Amber and Early Orange are used at Rio Grande, where planting can be finished by the 25th of April, and severe frosts are not expected before November 10th. At New Brunswick red shale soil sometimes cannot be prepared until the first of May. Planting is then delayed until the 10th, and frosts early in October are often heavy enough to ruin unripe cane. In this latitude Early Amber matures in time to allow the crop to be worked for either sugar or syrup. Experiments with Early

Orange, however, have thus far resulted unfavorably. The trial will be repeated next season upon lighter soil on which planting can be finished in April, and the season correspondingly prolonged.

In this year's experiments with varieties, the plots were measured off side by side upon sod ground, and planted May 14th with seed from Rio Grande; no fertilizers or manures were used in either case.

The cane was harvested October 14th, with the following results:—

	Amber.	*Orange.*
Total weight of cane per acre..	24,850 lbs.	31,400 lbs.
" " of stripped and topped cane per acre,	19,880 lbs.	23,237 lbs.
Per cent. of total sugar., ...	9.20	6.57
Total weight of sugar per acre	1,829 lbs.	1,527 lbs.
Per cent. of leaves..	8.53	12.50
Bushels of clean ripe seed per acre.	27.40	0.00

In case of the Orange, the comparison shows the high percentage of leaves, the low percentage of sugar, and the absence of ripe seed naturally expected in an unmatured plant. Its heavy yield of cane per acre, and the fact that it withstood without injury a storm which seriously damaged the Amber, indicate, however, what its value would be if the plant could be adapted to a short season without injury to its quality.

It is now believed that much may be accomplished in this direction, by growing this cane upon soil heavily dressed with phosphoric acid, and year after year selecting for seed those tops which ripen earliest.

An opinion is entertained that when short seasons are feared, not only should early ripening varieties be selected, but their seed should, if possible, be secured from cane grown where still shorter seasons are usual.

According to this theory, Amber grown in Minnesota from Cape May seed might not mature, while Amber grown at Cape May from Minnesota seed might ripen very early, much earlier, perhaps, than cane grown on the same field and planted at the same time with Cape May seed.

In order to note effects of climate and soil, a quantity of Amber seed from Minnesota, carefully selected by Mr. Seth Kinney, was divided by Professor Henry between the Experiment Stations of

Wisconsin, New York and New Jersey. Arrangements were not completed until the end of May, consequently little was expected from a crop planted late upon raw ground, without fertilizers or manure of any kind.

Station reports have not yet been interchanged, so that conclusions cannot be drawn at present upon the main object of the experiment. A comparison, however, can be made between the sorghum from Western seed planted about the 1st of June, and that from the College Farm seed planted May 14th. Both crops were grown without fertilizers, and both were harvested upon the 14th of October.

	College Farm Amber planted May 14.	*Western Amber planted June* 1.
Weight of cane per acre	24,850 lbs.	27,796 lbs.
Weight of stripped and topped cane per acre,	19,880 lbs.	22,709 lbs.
Per cent. of total sugar.	9.20	8.63
Total weight of sugar per acre..	1,829 lbs.	1,960 lbs.
Per cent. of leaves	8.53	7.70

The favorable results from the Western cane may, of course, be due to difference in the soil, or to some other cause entirely foreign to the locality whence the seed was obtained; until, however, more is known on this point, farmers in sections of this State less favored by climate than Cape May, will do well to give this matter careful consideration.

FERTILIZERS.

The following field experiment was planned to show the effects of fertilizers upon the quality and quantity of the crop:—

Uniform plots of one-tenth of an acre each were measured off upon sod ground. The fertilizers were used in the manner indicated in the table.

Nitrate of soda furnished the nitrogen, and dissolved bone black the phosphoric acid. Potash was used partly in the form of muriate and partly in the form of high grade sulphate. For comparison, Plot X was dressed with land plaster and Plot XI with barn yard manure. As this manure was used at the rate of twenty tons per acre, Plot XI received *nine times as much nitrogen, three times as much phosphoric acid, and nearly three times as much potash* as any other plot.

The intensely hot weather following May 14th, the date of planting, was decidedly unfavorable for sorghum. The soil "baked" hard, the amber seed germinated slowly, the "moping" period appeared to be unusually prolonged, and the plants in many hills perished, especially upon Plots XII to XVI, inclusive. For a long time the experiment was regarded as a failure, and received comparatively little attention. Later the development was remarkable, and the yield of cane from several of the plots was above the average; in quality, however, in all cases it fell far below previous results.

Upon the 14th of October, immediately after a heavy frost, about one hundred and fifty pounds of cane was selected from each plot, entire rows being cut out and all cane taken whether good or bad, large or small.

After the leaves and seed tops had been removed and weighed separately, the canes were cut into half-inch pieces and shredded in a Lion cutter and crusher. Sub-samples of twenty pounds were then drawn, and from each of these eleven pounds were rapidly dried in the large steam dessicator of a fruit preserving company.

From these dried samples portions for analysis were ground in a mill fine enough to pass through sieves twenty-five mesh to the inch.

The sugar was extracted from the fiber with alcohol by Scheibler's process, and after removal of the alcohol and clarification with basic lead acetate, the solutions were polarized according to Clerget.

The costs of the various fertilizers and their effects upon the crop can be seen in the table, from which the following conclusions are drawn:—

1. The cost of the muriate of potash used, and the expenses of its application were nearly repaid by the increased yield of seed alone; compare under bushels of seed per acre, Plot IV, with the averages of Plots I and VI.

2. By the use of muriate of potash alone the total weight of the crop was increased by 23 per cent., and the total weight of sugar per acre increased by 18 per cent.

3. No similar increase has followed the application of any other element or combinations of elements except in case of

Plot XI, upon which 200 pounds of potash were used, in form of barn yard manure.

4. Muriate of potash either caused an unusual development of leaves or else it retarded the ripening of the plant, in this respect resembling nitrogen.

5. Phosphoric acid appears to hasten the ripening of the crop; in this respect neutralizing the effect of both nitrogen and potash.

As the above conclusions are drawn from a single experiment, the effect of some unknown condition may be credited to the fertilizers. The liability of making this mistake is, however, much diminished by the results of four experiments made in 1881, 1882, 1883 and 1884, upon four different sections of the farm.

From the tabulated statement of these results the following conclusions are evident:—

1. Without exception, under all the varying conditions of soil and seasons, muriate of potash used alone has noticeably increased the total weight of the sorghum crop.

2. Without exception, this increase has, each year, exceeded that caused by phosphoric acid and nitrogen, used either alone or combined with each other.

3. Without exception, this increase has each year exceeded that caused by a combination of phosphoric acid and potash.

4. With a single exception, this increase has exceeded that caused—

   a. By combinations of nitrogen and potash.
   b. By combinations of nitrogen, potash, and phosphoric acid.
   c. By a dressing of twenty tons of barn yard manure.

It appears, therefore, to be demonstrated for this farm,

1st. That muriate of potash has a positive and favorable effect upon the growth of the sorghum.

2d. That muriate of potash in most cases influenced the weight of cane to a greater extent when used alone, than when used in combination with other elements of plant food.

In this Station's Report for 1883, the following statement was made: "Quantity of cane alone is no index to the value of a fertilizer as a sugar developer in sorghum."

It was then shown that a crop weighing less than seventeen tons per acre, contained five hundred and eighty pounds more sugar than one weighing nearly twenty tons per acre. It follows, therefore, that while muriate of potash used alone may be the fertilizer, above all others, for farmers who sell sorghum by weight; used alone, it may not be the best for sugar manufacturers, whose interests demand cane containing the highest possible percentage of sugar.

In 1881 and 1882, attention was directed only to the amount of sugar which could be expressed by a mill. This was a poor standard, as many conditions which it involved cannot be closely determined; with mills, too, no opinion whatever could be gained as to the *quantity of sugar remaining* in the *bagasse.*

In 1883 and 1884, therefore, milling as a standard of comparison between different plots was abandoned, and the total sugar which the crop contained was accurately determined. These figures indicate that potash is always associated with the heaviest yield of sugar per acre, but in 1883, the maximum was reached when potash was used with nitrogen.

In 1884, muriate of potash yielded more cane and more sugar when used alone than when combined with either nitrogen or phosphoric acid.

FIELD EXPERIMENTS WITH SORGHUM.

KIND AND QUALITY OF FERTILIZERS USED PER ACRE.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
							POTASH AS MURIATE.					POTASH AS HIGH GRADE SULPHATE.				
	Nothing.	Nitrogen 22½ lbs.	Phos. Acid 52½ lbs.	Potash 75 lbs. from Muriate of Potash.	Nitrogen 22½ lbs. Phos. Acid 52½ lbs.	Nothing.	Nitrogen 22½ lbs. Potash 75 lbs.	Phos. Acid 52½ lbs. Potash 75 lbs.	Nitrogen 22½ lbs. Phos. Acid 52½ lbs. Potash 75 lbs.	Land Plaster 400 lbs.	Nitrogen 204 lbs. Phos. Acid 164 lbs. Potash 200 lbs.	Potash 80 lbs.	Phos. Acid 52½ lbs. Potash 80 lbs.	Nitrogen 22½ lbs. Potash 80 lbs.	Nitrogen 22½ lbs. Phos. Acid 52½ lbs. Potash 80 lbs.	Nitrogen 22½ lbs. Phos. Acid, 106 lbs. Potash, 80 lbs.
Cost of Fertilizers per acre		$4.05	$5.25	$3.19	$9.30		$7.24	$8.44	$12.49	$1.50		$5.80	$11.05	$9.85	$15.10	$20.35
Pounds of Sorghum per acre	24,850	26,373	27,889	29,972	28,075	23,689	28,993	27,928	27,802	24,949	32,571	24,685	24,617	21,275	22,218	20,080
Tons of Sorghum per acre	12.4	13.2	13.9	15	14	11.8	14.5	14	13.9	12.5	16.3	12.3	12.3	10.6	11.1	10.0
Percentage of Leaves	8.53	8.92	8.04	10.06	8.60	9.89	10.24	9.09	8.02	8.61	8.42	8.27	8.44	9.79	7.46	2.45
Per Cent. of Stripped and Topped Cane	80.00	78.29	81.96	78.35	80.80	78.80	77.71	78.64	80.10	79.17	79.07	78.42	78.90	77.17	78.50	82.10
Pounds of Stripped and Topped Cane per acre	19,880	20,647	22,858	23,483	22,685	18,667	22,530	21,963	22,269	19,752	25,754	19,358	19,423	16,418	17,441	16,486
Per Cent. of Sugar in Stripped and Topped Cane	9.20	8.25	7.61	8.69	7.94	8.62	8.78	8.34	8.77	8.83	8.29	8.95	7.95	8.15	9.10	8.93
Total Amount of Sugar in Pounds per acre	1,829	1,703	1,739	2,041	1,801	1,609	1,978	1,832	1,953	1,744	2,135	1,733	1,544	1,338	1,587	1,472
Bushels (56 lbs.) of Clean Dry Seed per acre	27.4	31.0	26.7	33.5	31.5	25.4	35.1	36.0	33.5	26.0	36.4	30.2	28.5	24.8	26.1	26.1

SUMMARY OF EXPERIMENTS IN 1881, 1882, 1883, AND 1884.

KIND AND QUANTITY OF FERTILIZERS USED PER ACRE.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
								POTASH AS MURIATE.					POTASH AS HIGH GRADE SULPHATE.				
	Year.	Nothing.	Nitrogen 22½ lbs.	Phos. Acid, 52½ lbs.	Potash 75 lbs. from Muriate of Potash.	Nitrogen, 22½ lbs., Phos. Acid, 52½ lbs.	Nothing.	Nitrogen, 22½ lbs. Potash, 75 lbs.	Phos. Acid, 52½ lbs. Potash, 75 lbs.	Nitrogen, 22½ lbs. Phos. Acid, 52½ lbs. Potash, 75 lbs.	Land Plaster, 400 lbs.	Nitrogen, 204 lbs. Phos. Acid, 164 lbs. Potash, 200 lbs.	Potash, 80 lbs.	Phos. Acid, 52½ lbs. Potash, 80 lbs.	Nitrogen, 22½ lbs. Potash, 80 lbs.	Nitrogen, 22½ lbs. Phos. Acid, 52½ lbs. Potash, 80 lbs.	Nitrogen, 22½ lbs. Phos. Acid, 105 lbs. Potash, 80 lbs.
Pounds of Sorghum per acre	1881	11,515	14,820	13,365	16,000	14,440	11,170	12,390	11,640	12,590	12,680	12,375	11,605	11,650	12,505	13,260	14,030
" " " " "	1882	29,840	31,670	28,180	33,320	32,020	29,740	36,370	31,750	37,420	30,920	29,700	24,320	23,330	26,030	31,560	32,800
" " " " "	1883	31,040	31,930	35,200	39,390	33,530	33,220	36,780	33,680	32,860	32,820	38,590	36,740	29,790	36,320	33,600	33,180
" " " " "	1884	24,850	26,373	27,889	29,972	28,075	23,689	28,993	27,928	27,802	24,949	32,571	24,685	24,617	21,275	22,218	20,066
Total Amount of Sugar in pounds per acre	1881	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
" " " " " " " "	1882	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
" " " " " " " "	1883	3,872	3,542	3,830	3,963	3,260	3,426	4,582	3,355	3,452	4,215	4,119	4,243	3,833	4,866	4,547	4,309
" " " " " " " "	1884	1,829	1,703	1,789	2,041	1,801	1,609	1,978	1,832	1,953	1,744	2,135	1,733	1,544	1,338	1,587	1,472
Pounds of Clean Seed per acre	1881	1,020	1,296	1,351	1,246	1,344	1,132	1,067	1,038	1,305	1,136	1,160	1,216	1,226	1,189	1,849	1,278
" " " " " "	1882	1,095	785	620	370	330	510	490	320	295	290	290	500	670	470	680	790
" " " " " "	1883	1,770	1,462	1,898	2,190	1,842	1,725	2,055	1,887	1,837	1,680	2,128	1,904	1,400	1,868	1,546	1,658
" " " " " "	1884	1,534	1,736	1,495	1,876	1,764	1,422	1,966	2,016	1,876	1,456	2,038	1,691	1,596	1,389	1,462	1,462

SORGHUM.

II.

HISTORY OF THE CAPE MAY PLANTATION, AND EXPERIMENTS UPON THE EXTRACTION OF SUGAR.

In 1879 a New Jersey farmer sent samples of sorghum molasses to J. Hilgert & Sons, sugar refiners in Philadelphia. An examination of these samples created the impression that profitable plantations might be established in the southern counties of this State.

To test this opinion, Mr. Henry A. Hughes, of Camden, in the spring of 1880, planted Early Amber seed at Bennets, a station a few miles north of Cape May City. In the fall the juice from this cane was concentrated in an open evaporator and shipped to Philadelphia, where its sugar was crystallized in a vacuum pan.

The experiment was a decided success: it indicated, however, that the establishment of this industry would involve more labor and expense than private individuals could be expected to assume. Senator Miller, of Cape May County, therefore, induced the Legislature to enact a law which provides that the State shall pay a bounty of one dollar on each ton of material out of which merchantable sugar has actually been extracted: it provides, also, that an additional bounty of one cent shall be paid on each pound of sugar extracted from such material.

This act encouraged capitalists to build and equip the Rio Grande Sugar House, an undertaking, in 1881, involving an outlay of sixty-two thousand dollars. Subsequent additions of machinery and purchases of lands have increased this investment to two hundred and fifty thousand dollars.

Before the house was built contracts were made for all of the sorghum which could be grown on about seven hundred acres.

The farmers agreed to bear all the expenses of raising and harvesting the crop. In return, they were to receive two dollars for each ton of stripped and topped cane, to be delivered in bundles not exceeding twenty-five pounds each in weight.

Under this contract the owner of the sugar house had no claim, either upon the seed or upon the State bounty for the sorghum; both of which belonged to the planter.

The first season resulted in a financial failure. The weight of the sorghum per acre was much less than had been expected, while the expenses of growing, stripping and topping the cane exceeded all calculations. An accident to the machinery, at the beginning of the grinding season, stopped mill work for more than two weeks. During this time the farmers continued to deliver their crops according to their contracts until hundreds of tons lay in the factory yard, undergoing chemical changes which made the extraction of merchantable sugar impossible. This demonstrated that the mill superintendent must have absolute control of the cane supply; a conclusion which forced the mill owners to purchase over two thousand acres of land, in order to have a plantation which they could manage as their interests might dictate.

In 1882 they planted nine hundred and sixty-three acres, using Early Amber and Early Orange seed. The yield was six thousand two hundred tons of stripped and topped cane, from which three hundred and twenty thousand pounds of sugar and forty thousand gallons of syrup were obtained.

In 1883 the crop from nine hundred and sixty-three acres was reported to have been six thousand seven hundred and sixty-one tons of topped but unstripped cane. The product was two hundred and eighty-three thousand pounds of sugar, and fifty-five thousand gallons of syrup. Within certain limits the product is controlled by the market, syrup being at times in demand and relatively a trifle more profitable to produce than sugar. The marked decrease in this year's sugar production was, however, largely due to a gale of wind, which damaged three thousand tons of Amber cane, and thereby abnormally increased the yield of syrup.

In December, 1883, Messrs. Geo. C. Potts & Co., of Philadelphia, leased the plantation and sugar house for a period of five years; Mr. Hughes, who has been identified with this undertaking from the beginning, retaining his position as general superintendent.

Efforts were redoubled to increase the production and to reduce all working expenses. The direct management of the farms was placed in the hands of an experienced man, Mr. Miller, who, in consideration of two dollars and seventy-five cents for each ton of topped but unstripped cane, contracted to assume all the expenses for labor incurred in raising, harvesting and transporting the crop to the mill. His contract also required him to remove the bagasse, and spread it over the fields from which the cane had been taken.

On this plantation the cane, bagasse, &c., are transported by means of a narrow gauge railroad which now includes more than six miles of track. During the spring this road was thoroughly repaired and equipped; a good deal of the work on new cars being done in the machine shop connected with the sugar house.

A guillotine for topping cane was constructed near the mill, and ten weeks of constant use proved that it could easily do the work which formerly busied a large force of men and boys. The knife, heavily weighted and allowed to fall eight feet, removed at a single blow ninety per cent. of the seed from bundles of cane weighing at least three hundred pounds each. The bundles were then swung upon the carrier, untied and passed up to the mill, while the seed tops were elevated into a reservoir from which they were dropped into a cart, drawn to a neighboring field, dried in the sun and stacked, to be used as food for swine.

The herd at present numbers between five and six hundred pigs and hogs. During the summer they range the woods and salt meadows, finding an abundance of food; in the fall they are penned and fattened with boiled cane seed. It is confidently believed that ripe sorghum seed, thoroughly boiled and fed while fresh and sweet, rivals Indian corn both in the quality and quantity of the pork produced; but it is also known that a decidedly unfavorable effect may be caused by feeding musty seed or seed mixed with a noticeable quantity of sand and dirt.

As much bagasse as possible is packed into the pens to keep the pigs clean and dry; their freedom from disease and the rapidity with which they are fattened show the wisdom of this plan. Bagasse which cannot be used in the pens is mixed with land plaster to hasten decomposition, and is then composted with abattoir manure, hundreds of tons of which are each year used on the fields in addition to large quantities of compost from pens and stables, supplemented by lime, plain superphosphates, etc.

The introduction of improvements, and the changes in the method of managing field work, have already borne fruit. Mr. Miller's contract to deliver cane for two dollars and seventy-five cents per ton, which last season appeared to be favorable for the mill owners, has just been renewed for next season at two dollars and twelve cents per ton.

In the sugar house equal energy has been displayed, particularly by using machinery to the best advantage, by avoiding unnecessary expenses, and by detecting wastes and determining their extent.

One serious objection to this industry in the minds of moneyed men is, that capital invested in sorghum machinery can generally be used for a few weeks only in each year. Mills are operated day and night during the grinding season, but an equivalent of five months' service is even then seldom exceeded. During the past twelve months the Rio Grande house has been idle only in January, February and March. While the sorghum was growing, a portion of the machinery was used in working cargoes ot Cuban molasses.

In skillful hands a gallon of this molasses, weighing eleven and three-eighths pounds, can be made to yield from five to five and one-half pounds of unrefined sugar, and about forty-five per cent. of syrup. This year the unexpected fall in the prices of sugar prevented the profits usual in this business, and limited the gains to the very considerable advantage of holding together a body ot men trained for working sorghum.

The following serves as an example of the manner in which capital may be economized in equipping a sugar house. It was believed that labor and steam might be saved by substituting a single vat of six thousand gallons capacity for a number of copper defecators holding five hundred gallons each. A cedar tank, with its steam coil costing less than three hundred dollars, has been found to fully answer the purpose, practice failing to detect any of the disadvantages which theory regarded as probable. A saving of more than two thousand five hundred dollars could have been effected, had this fact been known when the sugar house was built.

Records of all work are accurately kept and serve as guides for avoiding mistakes and losses. The daily waste of juice, for instance, in the scum from settling tanks, at first sight appears to be trifling; the books at the close of this season proved, however, that the total loss from this waste was equivalent to the product from seven hundred tons of cane; sufficient, if economically saved, to pay for nearly two-thirds of the coal burned in working a crop of sorghum.

The most serious waste in the cane sugar industry is caused by the inefficiency of the mills; the best of which leave a large proportion of the sugar in the bagasse. Supplementary mills are sometimes employed, but they do not overcome the difficulty, one used last season at Rio Grande being this year replaced at considerable expense by a diffusion battery.

Diffusion is probably the best process known for extracting sugar from cane; repeated experiments showing that six thousand gallons of juice, density 6° to 7° Baume, can be diffused out of the bagasse from about eighty tons of cane; this cane having previously yielded nine thousand gallons of mill juice, density 8° Baume.

After two weeks' trial last September, a scarcity of water, coupled with the bitter taste and dark color of the diffusion products, obliged the superintendent to temporarily abandon the process. In November experiments were again carried out with very encouraging results; details of this work are given on a subsequent page.

It now appears that ten thousand tons of sorghum were received at the mill during the season of 1884; seven thousand two hundred and eight tons of unstripped and untopped cane were grown on nine hundred and seventy-nine acres of land belonging to the sugar house, and two thousand seven hundred and seventy-six tons of topped cane were purchased from neighboring farmers at three dollars and twenty-five cents per ton. The house worked all of this material, and produced from it three hundred and seventy-six thousand pounds of merchantable sugar and eighty-seven thousand gallons of syrup.

The sugar was readily sold at four and three-eighths cents per pound, 85° test: bids being received in November for sugar still in cane standing in the fields. Up to that time the syrup remained unsold, no reason existing for forcing it upon an unfavorable market.

Mr. Potts now states that next season the expenses of the sugar house alone will be reduced twenty-five per cent., making the cost of extracting the sugar one dollar per ton of unstripped and untopped cane.

RESULTS OF A SECOND TRIAL OF THE PROCESS OF DIFFUSION AT THE RIO GRANDE SORGHUM SUGAR WORKS.

During the last week's work of this season, at the request of the Director of this Station, Mr. Potts arranged for a second trial of the diffusers, and allowed the Station's chemist to be present and to take part in the study of the following questions:

(1) What percentage of the total sugar in the cane is expressed by ordinary milling?

(2) What percentage of the total sugar in the cane can be extracted from mill bagasse, by the diffusion process; and where in this process do noticeable losses of sugar occur?

(3) What causes the bitter taste and dark color in diffusion juices, and how can these faults be corrected?

Seventy-nine and seven-tenths tons of unstripped and untopped cane were taken for the experiment; about ninety per cent. of the seed was removed by the guillotine. The unstripped cane was slowly ground, and its bagasse at once diffused. The time required for this work was twenty-six consecutive hours.

A ton of unstripped and untopped sorghum was found to contain *one hundred and sixty-nine pounds of cane sugar*; of this, one hundred and eleven pounds were expressed in one hundred and twenty-six gallons of mill juice, and fifty-eight pounds were left in the bagasse. The averages of eight weeks' work show, that in actual practice this mill, instead of eighty tons, crushes one hundred and seventy-five tons of cane in twenty-four hours; but, under these conditions, a ton yields one hundred and two gallons, instead of one hundred and twenty-six gallons, of juice. In practice, therefore, the mill juice from one ton of this cane would contain ninety pounds, and the mill bagasse would hold seventy-nine pounds, or nearly forty-seven per cent. of the total sugar.

The answer to the first question is: *Ordinary milling, at Rio Grande, expresses from unstripped cane fifty-three per cent. of the total sugar.*

The losses of sugar in the diffusion process were found in the waste water from the battery and in the cells of the diffusion bagasse; they aggregated seven hundred and nine pounds, or five and three-tenths per cent. of the total sugar in seventy-nine and seven-tenths tons of sorghum. By a slight modification, waste water can be entirely avoided, and the loss thereby reduced to two hundred and seventy-eight pounds, or about two per cent. of the total sugar. The answer to the second question is: *The diffusion process removes, from mill bagasse, forty-one and one-half per cent. of the total sugar developed in the cane; but changes can be made in this process which will increase the yield to nearly forty-five per cent.*

Efforts to remove the bitter taste and dark color from diffusion juice proved unsuccessful. Working the battery at low temperatures, (30° R.) and using excessive quantities of clarifying reagents caused no perceptible improvement in the product.

The impression has prevailed for years, in certain localities, that, when sorghum leaves and seed tops are crushed with the cane, they make the molasses bitter and black. When leaves are steeped in warm water, as in the diffusion process, this trouble is intensified, and of all the reagents admissible in a sugar house, Bone black alone seems capable of coping with it. Mr. Hughes has, however, recently proved that ripe cane, carefully stripped and topped, can be digested for hours in water kept near its boiling point, and will then yield a solution practically as free from disagreeable taste and color as mill juice. The application of the diffusion process to the sorghum sugar industry depends upon this fact; and although it has not yet been shown to hold good for green cane the probabilities warrant the immediate construction of a machine for thoroughly stripping and topping the crop. If the machine now planned does its work, the introduction of the diffusion process will be easily accomplished.

The answer to the third question is: *The dark color and bitter taste of diffusion juice results principally from steeping the leaves and seed hulls; this trouble, therefore, can probably be avoided by stripping and topping the cane.*

By a comparison of mill juices and study of the records it can be demonstrated that this year's sorghum could not have averaged less than one hundred and sixty-nine pounds of total crystallizable sugar per ton; consequently the ten thousand tons crushed must have contained at least one million, six hundred and ninety thousand pounds of sugar.

Of this, eight hundred and ninety-five thousand pounds were expressed in the mill juice and seven hundred and ninety-five thousand pounds were wasted in the mill bagasse.

Had it been possible this season to combine milling and diffusion, ninety-eight per cent. of the total sugar, or one million, six hundred and fifty-six thousand pounds could have been separated from the cane; and ninety per cent., or one million, five hundred and twenty thousand pounds could have been obtained, partly as crystallized sugar and partly as merchantable syrup. If converted into syrup alone, the product could have been nearly two hundred and thirty-five thousand gallons, or twenty-three and one-tenth gallons per ton of unstripped and untopped cane.

SORGHUM.

III.

GENERAL REMARKS UPON THE SUGAR INDUSTRY.

The enormous losses of sugar, noted above, are by no means peculiar to the Rio Grande works or to the Sorghum industry. It is claimed that they characterize all plantations where ordinary mills are used for separating sugar from cane fiber. Planters, in many cases, have been fully informed as to the extent of these wastes, and have made efforts to avoid them; but experiments have generally been regarded unfavorably whenever the proposed improvement rendered it necessary to abandon the mills.

In 1873, for instance, a thorough trial of a diffusion battery was made in Louisiana, and the results then proved the marked superiority of the method. Yet, owing either to a failure to thoroughly understand the matter, or through reluctance or inability to incur the expense involved, the planters declined to interest themselves in the process.

The cane industry at that time had no formidable rival, and little real necessity existed for avoiding wastes, common to all sugar producers.

But conditions now are changing rapidly. Sixty years ago the tropical cane nearly crushed the sugar beet; to-day it appears possible that the tables may be turned. Sixty years ago the Beet Sugar Industry was kept alive only by Government assistance and encouragement; to-day this industry, in Germany at least, aids materially in supporting the government, while cane sugar has not only practically disappeared from Continental markets but is now forced to compete with beet sugar, both in England and in the United States.

Favorable conditions affecting labor can hardly be accepted as the explanation of this change, unless, indeed, it can be shown that German and French peasants work for lower wages than Cuban slaves and coolies.

The attitudes of the governments have doubtless had much to do with the matter; but the intelligent manner in which the Beet Sugar Industry has helped itself is the real solution of the question. By employing the highest chemical and mechanical skill, it has not only learned to avoid losses of sugar and to utilize waste production, but it has also very noticeably improved the quality of the beet and is now able to control its growth, hastening or retarding the ripening process in accordance with the demands of the sugar factories. The cane industry in the United States must profit by this example, or it will each year feel more keenly the effects of competition.

Admitting that the time for energetic action is at hand, the question at once arises: How can most be accomplished at least expense? No plan now appears preferable to that adopted in 1811 by Napoleon the Great.

In order to develop the Beet Sugar Industry in France, he decreed that pecuniary inducements should be held out to capitalists. At the same time he established schools in which chemists, and others inclined by previous training for this business, should be instructed theoretically and practically in the details of sugar production and extraction.

By thus preparing a body of men for their work, he increased the confidence of capitalists and materially diminished the opportunities for discouraging mistakes and failures. Germany followed a similar course, and the result was that in a very short time several hundred well equipped and well managed factories were in active operation. The industry rapidly became deeply rooted, and although for a time it was seriously crippled, it was not permanently injured either by Napoleon's downfall or by the removal of the Continental Blockade.

Students from these schools carried their work into Austria and Russia, and to-day forty per cent. of the world's sugar is extracted from European beets.

The work performed at that time by these schools is now divided between colleges and experiment stations. In the former the stores of knowledge acquired in the past are imparted to students; in the latter these stores are constantly increased by the labors of trained men who devote all their energies to investigation alone. A close relation is established between these Stations and various partially developed industries. The Station officials familiarize themselves with all practical details, they test all so-called facts, they sharply define and carefully study troublesome problems, and when reliable information is obtained they publish it for the benefit of all interested.

Teachers embody the results in their lectures, and students are thus constantly informed of the rapid changes common to new undertakings.

Many of the conditions which existed in France in 1811 exist in this country to-day.

Climate and soils, in various sections of the Union, have been proved by experiment to be adapted – not to one—but to all four leading sources of sugar, viz.: portions of the Southern States to the tropical cane, and portions of the Northern States to the maple; the Pacific coast States, in particular, to the beet, and several of the Mississippi valley and Atlantic States to the sorghum.

The attitude of the Government has always been favorable to the development of domestic resources, and capital in abundance can be secured for any legitimate and reasonably profitable undertaking.

The great drawback is the very small number of men competent to successfully manage plantations and sugar works. To supply this want, Napoleon was obliged to establish special schools, but in America every State already has its college organized to educate men in the principles of agriculture and mechanic arts.

The development of a new undertaking, however, depends upon costly experiments and patient investigations for which no provision was made when State schools were established. This work is properly the legitimate field of experiment stations, and when each college can look to such an institution for information, young men can then be properly prepared for developing the sugar or any other industry for which favorable conditions exist.

FIELD TRIALS WITH WOOL WASTE AS A WHEAT FERTILIZER.

As early as 1845 experiments with wool waste as a fertilizer were made under the direction of the Royal Agricultural Society of England.

In that year Mr. Pusey, M. P., president of the society, planned and carefully conducted a series of field experiments.

His aim was to study the following questions:

First. What is the limit beyond which an increased quantity of dung ceases to act?

Second. Is it better to dress with dung alone, or with a combination of dung and artificial manure?

These experiments were made upon yellow globe beets; wool waste occupied a prominent position among the artificial manures.

The single dressing of dung added twelve tons to the crop; doubling the amount of dung did no good.

Wool waste, combined with the single dressing of dung, increased the yield by twenty tons per acre.

The conclusions, therefore, are:

First. That there is a limit beyond which additional quantities of dung are of no use.

Second. That it is most profitable to use artificial manure in combination with the dung.

The following table is taken from Mr. Pusey's report:

Number of Plot.	Amount of Dung.	Artificial Manure.	Tons of Cleaned Roots Per Acre.
1	26 Loads	....	28½
2	13 "	....	27½
3	13 "	700 lbs. Rape Dust.	27
4	13 "	14 bu. Bone Dust.	26
5	13 "	700 lbs. **Wool Waste.**	36
6	13 "	300 " Guano.	36
7	....	700 " Rape Dust.	20½
8	....	14 bu. Bone Dust.	20
9	....	300 lbs. Guano.	20½
10	....	700 " **Wool Waste.**	20
11	....	Unmanured.	15½

It is clearly shown from the above, that wool waste used alone, did not produce the same effect as when used in combination with dung.

EXPERIMENTS WITH WOOL WASTE UPON WHEAT, BY MR. JOHN VOORHEES OF SOUTH BRANCH.

The field upon which this experiment was made contains twenty-five acres, and is divided by a farm road into two plots, one of fourteen acres, and one of eleven acres.

The soil is a clay loam, with clay subsoil. Previous treatment has been a regular rotation of corn, oats, wheat, hay and pasture; a dressing of barnyard manure being applied upon each wheat crop.

Of the fourteen acres in one plot, thirteen acres were dressed with two hundred loads of barnyard manure, and one acre with four hundred pounds of a complete fertilizer.

The yield for this plot was two hundred and forty bushels; *an average of seventeen and one-tenth bushels per acre.*

Of the eleven acres in the other plot, nine acres were dressed with eleven tons of wool waste composted with thirty-three loads of barnyard manure; this dressing was supplemented with two hundred pounds of bone black superphosphate per acre, sown broad-cast, just before the grain was drilled. The two remaining acres of this plot received bone black alone, at the rate of two hundred pounds per acre.

The total yield from eleven acres was two hundred and seventeen bushels, *an average of nineteen and seventy-five hundredths bushels per acre.*

It follows, therefore, that the product from *three loads of barnyard manure, supplemented by one ton of wool waste and two hundred pounds of bone black superphosphate was more profitable* than the product from *fifteen loads of barnyard manure.*

CONDITIONS AFFECTING THE EXPERIMENT.

The wheat, upon moist portions of the field, where large quantities of barnyard manure had been applied, was badly damaged by the hessian fly.

Where bone black was used, either alone or in combination with wool waste and small quantities of barnyard manure, or wherever a complete manure was used, no damage by the fly was noticeable.

An interval of five days existed between the sowing of the two portions; the fourteen acre plot, *dressed with barnyard manure alone*, was sown first. It can, however, be shown that the time of sowing had *no influence upon the development of this fly*, for the acre upon which a complete fertilizer was used, sown the same day, and containing a proportionate area of undrained land, was free from the pest.

It is fair to conclude, therefore, either that barnyard manure in large quantities favored the action of the fly, or that artificial fertilizers in some way destroyed the insect.

The grass at the beginning of winter was equally good upon both portions.

It is admitted that the results from the use of wool waste have not always been as favorable as the above would indicate.

Dr. Voelker, late chemist of the Royal Agricultural Society of England, states that in his experience cases have occurred where no returns have been received from its use.

He finds an explanation of these failures in the oil with which wool waste is generally saturated. This oil prevents decay, and unless its effects are neutralized, the waste remains undecomposed in the soil.

Various methods have been sought to avoid this injurious effect of the oil.

In Mr. Voorhees' case the decomposition was started by composting with barnyard manure. In an experiment with wool waste upon wheat on the College Farm the oil was saponified with a caustic alkali. A chemical analysis of this wool waste showed that it contained 6.95 per cent. of nitrogen.

This experiment, conducted the past season, included five plots, each two yards wide and two hundred and thirty yards long, in area, therefore, about one-tenth of an acre.

No fertilizer was applied upon Plot No. 1.

Plot No. 2 received ninety pounds of 40 per cent. caustic potash, which was dissolved in water, thoroughly mixed with about one ton of soil, and applied broadcast.

Upon Plot 3, thirty-five pounds of bone black superphosphate were drilled in with the wheat.

Two hundred pounds of wool waste, saturated with a solution of ninety pounds of caustic potash, were applied to Plot 4, in addition to thirty-five pounds of bone black superphosphate drilled with the seed.

The mixture of wool waste, caustic potash and about one thousand pounds of earth was allowed to lie four days before being applied.

The two hundred pounds of wool waste upon Plot 5 was simply mixed with dry earth and applied broadcast.

Two bushels of wheat per acre were drilled September 28, 1883.

Observations taken April 13th, 1884, showed Plot 5 little, if any, in advance of Plots 1, 2 and 3. Plot 4 appeared decidedly benefited by the fertilizers. Again, April 20th, Plots 3 and 4 were a much lighter yellow than Plots 1, 2 and 5. Plot 4 still decidedly larger and better developed than the others.

Number of Plot.	FERTILIZERS.		YIELD OF WHEAT AND STRAW PER ACRE.		
	Kind.	Amount per Acre.	Pounds of Wheat.	Bushels of Wheat.	Pounds of Straw.
1	Nothing	....	915	15.2	1335
2	Caustic Potash..........................	900 lbs.	1090	18.1	1760
3	Bone Black Superphosphate... Caustic Potash..........................	350 1900 “	1185	19.8	1845
4	Bone Black Superphosphate... Wool Waste..........................	350 2000 “	1455	24.3	2445
5	Wool Waste..........................	2000 “	1202	20.0	1948

Caustic potash alone increased the yield above no manure by *two and nine-tenths bushels per acre;* bone black alone, by *four and six-tenths bushels;* wool waste alone, by *four and eight-tenths bushels,* and a combination of the three ingredients, by *nine and one-tenth bushels per acre.*

During the process of saturating the wool waste with caustic potash, there was a strong evolution of ammonia, indicating not only that the effect of the oil was neutralized, but that the wool fiber was being attacked by the caustic.

The above yields, however, do not clearly indicate whether the gain upon Plot 4 is due to the increased value of the saturated wool waste, or to its combined action with phosphoric acid and potash.

The experiment was of sufficient value, however, to warrant its repetition upon a larger scale. One and two-tenths acres of land upon the College Farm, divided into twelve plots, were therefore again devoted to this experiment in the fall of 1884.

This second trial has been so planned that results will show whether any improvement in the quality of the nitrogen in the wool waste has been caused by the alkali.

FODDERS AND FEEDS.

All analyses of fodders and feeds, made during the past year, have been tabulated for convenience of reference.

In most cases the analyses were carried out, either to be used in calculating feeding rations, or for affording a means of comparison between crops.

EXPLANATION OF TERMS.

The following description is taken from the last annual report of this Station.

In the analyses, the ingredients of fodders are separated into the five following classes:

CRUDE PROTEINE, CRUDE FAT, CRUDE FIBER, CARBHYDRATES, ASH.

The term *proteine* is used to designate a group of compounds, some of which are well known. The elastic substance which remains when wheat flour is kneaded under water, is, for example, a member of this class; its specific name is *gluten.* The white solid in a hard-boiled egg is another member of this class; and is known as *albumen;* when fresh blood is whipped with a bundle of twigs it coagulates; the red coloring matter can then be washed out, and the white solid remaining is a third member of the class, known under the name of *fibrin.*

Gluten, albumen and *fibrin*, while differing widely in appearance, agree closely in chemical composition, each having, in a pure and dry condition, sixteen per cent. of nitrogen; this percentage of nitrogen is the characteristic feature of this class.

Fodders and feeds, without exception, contain some member of this group; but as the labor of separating the compound is in many cases considerable, and in some cases excessive, the usual plan of making an analysis is simply to determine the percentage of nitrogen, and from this calculate the proteine.

The class of compounds known as *fats* also differ widely in appearance; butter, lard and tallow being solid at ordinary temperatures, and olive and cotton-seed oil fluid. In chemical composition all are closely allied, and while insoluble in water, are all readily soluble in certain re-agents, as ether, etc. In fodder analysis all substances soluble in ether are grouped as *crude fat.*

Paper pulp and cotton lint are two of the best examples of the class *crude fiber*, and sugar and starch of the class *carbhydrates.*

Ash signifies the residue remaining when a fodder or feed has been burned. It contains the mineral matters extracted by the growing plant from the soil, and in composition varies, of course, with the nature of the fodders. Without exception, however, it contains phosphoric acid, potash, lime, magnesia, soda, sulphuric acid, &c.,—all substances indispensable to animal life.

Interesting experiments have been made to show the effects which follow when animals are deprived of potash.

Two dogs were fed upon meat from which, as far as was possible, the ash had been removed by boiling and washing with water. In one case potash salts were mixed with the meat; in the other case a sufficient quantity of ordinary table salt was used.

Both dogs ate freely and increased considerably in live weight; the one, however, which received the table salt, lost strength rapidly, lay quietly in a corner the greater part of the time, and gave many indications of extreme sickness. The other dog, in whose food potash was mixed, remained active and perfectly well.

When, however, the rations were changed, potash given to the sick dog, and taken from the healthy one, their condition also changed, the well one became sick, and the sick at once recovered.

Other similar experiments have indicated that living creatures may be starved to death by simply withdrawing potash from their food.

In such cases, after death, their bodies exhibit an abundance of flesh indicating that even if everything, except water and potash, had been denied them, they might have lived for many days.

As a rule, in practice, stock obtain an excess of potash in hay and coarse fodder in general.

In some cases however a deficiency may occur; cows herded together in filthy stables and fed almost exclusively upon brewers' grains, probably suffer from want of potash, as a German investigator claimed several years ago.

It can in fact be seen in the following table of analysis, that brewers' grains contain only five-hundredths of one per cent. of this element.

Between two and three hundred tons of these grains are annually fed upon the college farm in connection of course with proper quantities of other food.

No disease whatever has occurred in this barn although this plan was introduced many years ago. The milk is, and always has been in demand, both for young children and for general household purposes.

DIGESTIBILITY.

The examination of the solid excrement of animals, invariably shows the presence of proteine, fat, and carbhydrates, which have passed undigested through the body.

This loss of food is dependent upon the kind of fodder, its mechanical condition, and upon the proportion existing between the proteine and carbhydrates in the ration.

Both the kind and amount of digested food can be determined in any case by subtracting the proteine, fat, and carbhydrates found in the excrement from the amounts known to exist in the feeds and fodders eaten.

In the following tables the quantity of digestible food has been calculated in each sample on the supposition that the fodder was in the best possible mechanical condition and was properly mixed.

COMPARATIVE VALUATIONS.

To make a striking comparison between the fodders and feeds tabulated, the plan adopted in the fertilizer control has been followed.

Money values have been assumed, and the various samples compared with each other upon this standard.

Digestible proteine and fat are valued at four and one-third cents, and digestible carbhydrates at nine-tenths cents per pound.

Calculated from these values, the relative price of corn meal is found to be $20 per ton, almost identical with its present market price.

Brewers' grains, when bought by the boat load, can be ensilaged in New Brunswick at a total cost of $3.20 per ton, at which price digestible proteine and fat costs but one and forty-four hundredths cents, and digestible carbhydrates thirty-three hundredths of a cent per pound.

Dried field corn stalks at $7 per ton, furnish digestible proteine and fat for two and thirty-two hundredths cents, and carbhydrates at forty-eight one-hundredths cents per pound.

The tables will afford opportunities for similar comparisons.

RATIONS.

Another practical use for which fodder analyses are valuable, is in making up rations.

For milch cows, experience teaches that two and one-half pounds of digestible proteine, four-tenths of a pound of fat, and twelve and one-half pounds of digestible carbhydrates daily are sufficient for each 1,000 pounds of live weight.

This food, however, must be contained in not more than twenty-five pounds of dry matter.

Tables, therefore, containing both the analyses of fodders and feed, and their percentages of digestible proteine, fat and carbhydrates, furnish the means for calculating and mixing rations, out of low priced products.

These tables show that gluten meal from starch works, grains from breweries, and meal from linseed oil works, can be used as sources of proteine and fat; while corn stalks and straw, waste products from the farm, furnish carbhydrates in excess.

Brewers' grains and linseed meal alone are known to be unhealthy foods; corn stalks alone will not produce a full flow of milk; but by mixing these materials together in proper proportions, a ration for milch cows is found which feeding trials, reported upon a subsequent page, have shown to be in no respect inferior to rations in which the corn stalks have been replaced in part by corn meal, or entirely by corn ensilage.

FOODS AND FODDERS.

Station Number.	BRAND.	Pounds per Hundred of						In One Hundred lbs. of Feed, Number of Pounds of Digestible				Cost per Pound of Digestible			Estimated Value per Hundred Pounds.	Market Price per Hundred Pounds.	Phosphoric Acid.	Potash.	Station Number.
		Water.	Crude Fat.	Crude Fiber.	Crude Ash.	Proteine.	Carb-hydrates.	Crude Fat.	Crude Fiber.	Proteine.	Carb-hydrates.	Crude Fat.	Proteine.	Carbhy-drates incl. Fiber.					
183	Clover Hay	10.20	2.51	30.83	7.45	12.13	36.88	1.88	18.19	8.85	29.50	2.40	2.40	0.50	0.89	0.50	0.66	2.20	183
184	Corn Ensilage	72.48	0.54	7.16	1.47	1.86	16.49	0.41	5.16	1.36	11.05	....	....	....	....	....	0.13	0.28	184
185	“ “	72.92	0.70	7.28	1.69	1.76	15.65	0.53	5.24	1.42	10.49	....	....	....	....	....	0.12	0.31	185
186	Green Corn	86.71	0.25	3.50	2.55	2.15	5.84	0.18	2.52	1.57	3.97	....	....	....	....	....	0.09	0.48	186
187	“ “	80.91	0.39	5.00	1.35	2.15	10.20	0.29	3.60	1.57	6.83	....	....	....	....	....	0.10	0.42	187
188	“ Clover	73.33	0.69	8.12	2.16	4.09	11.61	0.41	3.81	2.45	8.01	....	....	....	....	....	0.13	0.65	188
189	“ Corn	77.76	0.40	5.78	1.45	1.76	12.85	0.30	4.16	1.28	8.61	....	....	....	....	....	0.10	0.40	189
190	Sorghum Ensilage	74.92	0.19	6.53	1.19	0.66	16.51	0.16	3.92	0.41	12.88	....	....	....	....	....	0.05	0.19	190
191	“ “	76.65	0.20	5.90	.79	0.56	15.90	0.17	3.54	0.35	12.40	....	....	....	....	....	0.05	0.18	191
192	Green Corn	73.79	0.44	6.20	1.43	1.86	16.28	0.33	4.46	1.36	10.91	....	....	....	....	....	0.13	0.37	192
193	Sorghum	71.50	0.18	6.95	1.08	0.95	19.34	0.15	4.17	0.59	15.09	....	....	....	....	....	0.05	0.19	193
194	“ dried	61.59	0.31	8.49	1.24	1.33	27.04	0.26	5.09	0.82	21.09	....	....	....	....	....	0.06	0.18	194
195	“ Ensilage	71.94	0.14	6.79	1.19	0.92	19.02	0.12	4.07	0.57	14.84	....	....	....	....	....	0.04	0.20	195
196	Corn “	87.16	0.27	4.00	1.64	1.81	5.12	0.21	2.88	1.32	3.43	....	....	....	....	....	0.08	0.43	196
197	“ “	83.18	0.37	5.21	1.27	1.77	8.20	0.28	3.75	1.29	5.49	....	....	....	....	....	0.09	0.37	197
198	“ “	81.02	0.32	5.45	1.33	1.71	10.17	0.24	3.92	1.25	6.81	....	....	....	....	....	0.10	0.38	198
199	“ “	75.77	0.27	6.47	1.41	1.74	14.34	0.21	4.66	1.27	10.21	....	....	....	....	....	0.12	0.35	199
200	Ground Linseed Cake	10.59	4.00	8.83	6.15	34.19	36.74	3.64	2.17	29.75	33.43	3.98c.	3.98c.	0.83c.	1.77	1.62½	....	....	200
201	Linseed Meal	12.89	5.06	8.08	6.20	31.50	36.73	4.60	2.09	27.41	33.49	3.98c.	3.98c.	0.82c.	1.71	1.55	....	....	201
202	Ground Linseed Cake	10.80	4.90	8.48	4.98	31.81	39.11	4.46	2.19	27.67	35.59	4.06c.	4.06c.	0.85c.	1.73	1.62½	....	....	202

FOODS AND FODDERS.

Station Number.	BRAND.	Pounds per Hundred of						In One Hundred lbs. of Food, Number of Pounds of Digestible				Cost per Pound of Digestible			Estimated Value per Hundred Pounds.	Market Price per Hundred Pounds.	Phosphoric Acid.	Potash.	Station Number.
		Water.	Crude Fat.	Crude Fiber.	Crude Ash.	Proteine.	Carbhydrates.	Crude Fat.	Crude Fiber.	Proteine.	Carbhydrates.	Crude Fat.	Proteine.	Carbhydrates incl. Fiber.					
166	Brewers' Grains, from Silo	68.85	1.96	4.62	1.22	7.14	16.23	1.57	....	6.07	16.23	1.44	1.44	0.30	0.48	$0.16	....	....	166
167	" " " Car	75.27	1.70	3.16	0.86	5.65	13.37	1.36	....	4.80	13.37	2.90	2.90	0.60	0.29	0.26	....	....	167
142	Dried Brewers' Grains	6.43	6.01	11.20	3.82	20.19	52.35	4.81	....	17.16	52.35	3.02	3.02	0.63	1.42	1.00	....	....	142
83	Brewers' Grains	68.60	2.84	4.23	1.51	6.88	15.94	2.27	....	5.84	15.94	2.60	2.60	0.54	0.49	0.30	0.31	0.05	83
144	Clover Ensilage	72.60	0.93	8.57	2.69	3.81	11.41	0.66	4.80	2.82	8.79	....	....	....	....	....	....	....	144
168	Corn Meal	15.75	3.90	1.70	1.35	8.76	68.54	3.31	1.05	6.92	62.37	5.10	5.10	1.06	1.01	1.20	0.75	0.40	168
169	Field Corn Stalks	9.72	0.82	33.60	4.82	4.00	47.04	0.62	24.19	2.92	31.52	2.32	2.32	0.48	0.65	0.35	0.35	0.81	169
170	Corn Ensilage	71.86	0.32	7.35	1.24	1.72	17.51	0.24	5.29	1.26	12.61	2.88	2.88	0.60	0.23	0.15	0.15	0.29	170
171	Corn Cobs	17.20	0.29	28.35	1.33	1.94	50.89	....	....	....	....	....	....	....	....	....	0.27	0.50	171
172	Corn Ensilage	70.76	0.30	7.34	1.49	1.71	18.40	0.23	5.28	1.25	12.34	2.91	2.91	0.61	0.22	0.15	0.16	0.32	172
173	Sorghum Ensilage	78.03	0.46	6.14	0.88	0.66	13.83	0.39	3.68	0.41	10.79	3.94	3.94	0.82	0.17	0.15	0.06	0.17	173
174	Corn "	81.62	0.24	5.58	1.59	1.52	9.54	0.18	4.02	1.11	6.39	4.34	4.34	0.90	0.15	0.15	0.09	0.40	174
175	" "	82.05	0.23	4.93	1.44	1.52	9.83	0.18	3.55	1.11	6.59	4.42	4.42	0.92	0.15	0.15	0.09	0.40	175
176	Gluten Meal	9.92	4.18	1.04	1.04	29.50	54.32	3.55	0.64	23.31	49.43	2.83	2.83	0.59	1.61	1.05	....	....	176
177	New Feed	9.47	3.58	5.40	0.70	21.44	59.41	....	....	....	....	....	....	....	....	....	....	....	177
178	Field Corn Stalks	12.99	0.93	31.01	5.58	4.19	45.30	0.70	22.32	3.06	30.35	2.38	2.38	0.50	0.64	0.35	0.44	0.97	178
179	" " "	11.60	1.29	31.40	4.78	4.19	46.74	0.97	22.60	3.06	31.32	2.30	2.30	0.48	0.66	0.35	0.39	0.83	179
180	Brewers' Grains, from Silo	73.86	1.79	3.89	0.96	5.85	18.65	1.43	....	4.97	13.65	1.73	1.73	0.36	0.40	0.16	....	....	180
181	Corn Meal	16.60	3.92	1.91	1.55	8.44	67.58	3.33	1.18	6.67	61.50	5.19	5.19	1.08	1.00	1.20	0.67	0.41	181
182	Wheat Chaff	14.40	1.39	27.99	7.18	4.25	44.79	0.38	15.56	1.06	17.92	2.98	2.98	0.62	0.36	0.25	0.95	0.56	182

COMPARATIVE FEEDING VALUE OF MOIST AND DRIED GRAINS FROM BREWERIES.

During the winter season brewers have but little difficulty in selling moist grains at a fair price, as farmers, who use them properly, know that they favorably influence milk yields, and have no injurious effects upon the health of cows.

In the spring, however, when pastures are good and soiling crops are available, the demand for grains decreases, while the supply is largely increased; consequently the market is overstocked with a perishable article and dealers are obliged to accept any reasonable price offered.

Dairymen who can transport quantities, of from two to three hundred tons by boat, then fill their silos with a year's supply, at a cost far below that of an equivalent amount of food in any other material.

Producers from time to time have attempted to dry and store these grains for winter markets; the problems, however, involved in this work are not easily solved.

A ton of moist grains, for instance, contains approximately fifteen hundred pounds of water, the greater portion of which must be rapidly and economically removed without decreasing the feeding value of the product.

For nearly two years past the "Concentrated Feed Co.," of New York, have been thoroughly testing an apparatus, by which it is believed these conditions can be fulfilled. A working model was erected and from three to four tons of dried grains produced daily, with which very satisfactory feeding trials upon horses, cows, and swine are said to have been made.

A large factory planned from this model will soon be in working order, and there are indications that a considerable portion of New York's supply of moist grains will in the future reach consumers in a dried condition.

In the above process centrifugal machines, presses, and similar devices are avoided; these would remove more or less soluble matter with the water, and might thus involve noticeable losses of the most valuable portions of the food.

Exclusive of the question of cost, therefore, consumers' interests centre upon a single point, viz.:

Will dried grains yield as much milk as moist; can the drying process be carried out, without diminishing the digestibility of the product?

Answers to these questions were sought in a feeding trial, during which the following rations were used:

CLOVER ENSILAGE,

With Moist and Dried Grains.

RATION I.	Pounds of Digestible Fat.	Pounds of Digestible Proteine.	Pounds of Digestible Carbhydrates.	RATION II.	Pounds of Digestible Fat.	Pounds of Digestible Proteine.	Pounds of Digestible Carbhydrates.
40 lbs. Moist Grains..	.53	1.92	5.33	12 lbs. Dried Grains	.57	2.05	6.28
30 " Clover Ensilage..................	.20	0.85	4.08	30 " Clover Ensilage..................	.20	0.85	4.08
3 lbs. Chaff..............	.01	0.03	0.94	3 lbs. Chaff	.01	0.03	0.94
	.74	2.80	10.35		.78	2.93	11.30
Digestive Ratio........	1 : 4.36			Digestive Ratio......	1 : 4.52		

CLOVER HAY,

With Moist and Dried Grains.

RATION III.	Pounds of Digestible Fat.	Pounds of Digestible Proteine.	Pounds of Digestible Carbhydrates.	RATION IV.	Pounds of Digestible Fat.	Pounds of Digestible Proteine.	Pounds of Digestible Carbhydrates.
40 lbs. Moist Grains..	.53	1.92	5.33	12 lbs. Dried Grains	.57	2.05	6.28
12 lbs. Clover Hay....	.23	1.06	5.72	12 " Clover Hay..	.23	1.06	5.72
	.76	2.98	11.05		.80	3.11	12.00
Digestive Ratio........	1 : 4.35			Digestive Ratio......	1 : 4.50		

The complete analysis of fodders and feeds used in these rations are given in the preceding tables. Moist grains No. 167, dried grains No. 142, clover ensilage No. 144, wheat chaff No. 182, and clover hay No. 183.

Cows, VII and VIII, when fed moist grains and clover ensilage, averaged daily *twenty-one and two-tenths pounds* of milk per cow, a yield not materially changed when dried grains were substituted for the moist; twenty-one and three-tenths pounds per cow being then the average.

Moist grains taken from silos have a slightly acid taste, supposed to be due to *lactic acid;* grains dried without delay do not ferment and are consequently free from acidity.

An opinion was entertained years ago in England that *lactic acid* in small quantities increased the milk flow; it seems possible, therefore, that one advantage which moist grains may have over dried, was not brought out by the above ration; as clover ensilage used in both cases may have contained an excess of this acid.

The experiment was therefore repeated with *clover hay* substituted for *clover ensilage.*

Cows, VII and VIII, upon the dried grains and hay, averaged daily *twenty-one and four-tenths* pounds of milk per cow, practically the same as before; but upon substituting in this ration moist grains for dried, the yield was slightly increased; the daily average per cow being *twenty-two and one-half pounds.* While, therefore, no proof has been found that *lactic acid* influences the milk flow, it has been seen that passing from the dried grains to moist was followed by a slight increase in milk yield, a fact which cannot be due to moisture in the food alone, as the dried grains immediately before they were used were invariably soaked in water for several hours.

The experiment was repeated upon two other cows, IX and X.

Upon a ration of dried grains and clover ensilage the average daily milk yield was *twenty-two and three tenths pounds* per cow, followed however, by an increase to *twenty-three and nine-tenths pounds* per cow, when *moist grains* were substituted for *dried.*

RATION.	Number of Cow.	Average Daily Yields for Periods on Different Rations.			
		Feb. 27 through Mar. 10.	Mar. 11 through Mar. 23.	Mar. 24 through April 6.	April 7 through April 19.
Moist Grains, and Clover Ensilage.	VII	23.6			
Fat .74 lbs.	VIII	18.9			
Proteine 2.80 "	Average	21.2			
Carbhydrates 10.35 "					
Dried Grains, and Clover Ensilage.	IX	23.3			
Fat .78 lbs.	X	21.3			
Proteine 2.93 "	Average	22.3			
Carbhydrates 11.30 "					
Dried Grains, and Clover Ensilage.	VII		24.3		
Fat .78 lbs.	VIII		18.4		
Proteine 2.93 "	Average		21.3		
Carbhydrates 11.30 "					
Moist Grains, and Clover Ensilage.	IX		25.1		
Fat .74 lbs.	X		22.8		
Proteine 2.80 "	Average		23.9		
Carbhydrates 10.35 "					
Dried Grains and Clover Hay.	VII			24.7	
Fat .80 lbs.	VIII			18.1	
Proteine 3.11 "	Average			21.4	
Carbhydrates 12.00 "					
Moist Grains and Clover Hay.	IX			25.1	
Fat .76 lbs.	X			24.6	
Proteine 2.98 "	Average			24.8	
Carbhydrates 11.05 "					
Moist Grains and Clover Hay.	VII				25.3
Fat .76 lbs.	VIII				19.8
Proteine 2.98 "	Average				22.5
Carbhydrates 11.05 "					
Dried Grains and Clover Hay.	IX				25.5
Fat .80 lbs.	X				23.0
Proteine 3.11 "	Average				24.2
Carbhydrates 12.00 "					
Barn Ration	Average of Eight Cows.	19.8	19.7	20.0	19.4

With moist grains and clover hay the yield still further increased, amounting then to *twenty-four and eight tenths pounds* per cow, followed however, by a decrease to *twenty-four and two tenths* when dried grains were substituted for moist; this loss however, being caused entirely by cow No. X.

The preceding tabulated statement of rations and yields allows an easy comparison of results.

The yields of milk from a herd of eight cows fed upon the "barn" ration without changes, indicate that variations in the yield from the experimental cows are not due to weather or similar causes.

A strict interpretation of these results forces the conclusion that digestibility of the food is slightly diminished by the drying process, practically however, little difference in milk flow will follow the substitution of the dried grains for moist.

Farmers now using moist grains properly ensilaged can rest assured that dried grains as far as quality is concerned offer no marked advantages; while those who by reason of freights, etc., hitherto have not been able to use grains at all, will now find them, in a dried condition, within their reach.

Dried grains at $20 per ton are equivalent to moist grains at from ten to eleven cents per bushel; at this price they are somewhat dearer than cotton seed meal at $30 per ton, or gluten meal at $22 per ton.

In quantity one pound of dried grains contains as much food as three and one-half pounds of moist grains.

The director and chemist of the station visited the works where the dried grains are produced, and there inspected both the process and a quantity of the product then ready for shipment.

The impression was created that the dried grains used in the above experiment fairly represented the average product from this "plant."

ENSILAGE.

Results from previous experiments carried out upon the College Farm have shown:

1. That the food in corn ensilage produced no more milk than an equivalent amount of food in dried fodder corn.

2. That the losses of food, due to fermentation, are no greater when fodder corn is dried in shocks, than when fodder corn is placed in silos.

These conclusions indicate that the silo is simply a place in which green food may be preserved; not a place in which fodder may be stored with reasonable expectation of improving its quality.

Doubtless any farmer would be satisfied if, in midwinter, he could feed his milch-cows with green corn in all respects identical with that which he used the previous summer for soiling. Cases have indeed occurred where ensilage, in many respects, has closely resembled green fodder corn, but such cases are rare, and farmers who have succeeded one year have failed the next—and that, too, without being able to determine the causes of either success or failure.

It has been surmised that there may be a stage in the growth of fodder corn at which it is best suited for ensilage; that if cut and packed at this stage it may keep without becoming acid.

The point has been regarded as worthy of study, for which the preliminary steps were taken during the past summer.

At intervals of one week, four equal areas of fodder corn were cut, weighed, and prepared for ensilage. Analysis of samples from each plot, taken at the time the corn was cut, indicated the increase in the amount of food per acre due to each week's growth. Quantities of about two hundred pounds, representing each plot, were packed in tight oil casks which served as silos; these allowed the temperature, rapidity of fermentation, and loss in weight to be closely studied. At the end of the experiment an examination of samples from each barrel gave reliable information as to the relative fitness for ensilage of each lot of corn.

Results can not be reported at present. It is expected, however, that they will be published in bulletin form at an early date.

Other questions of importance, bearing upon ensilage, can be found in the detailed comparison between field corn and ensilaged fodder corn on the following pages.

COMPARISON BETWEEN FIELD CORN AND ENSILAGED FODDER CORN.

The interest awakened by the discussion of ensilage, has created a demand for a comparison between field corn and fodder corn.

This comparison involves the following questions:

I. How much digestible food can be secured from one acre planted in field corn, and how much from a corresponding acre planted in fodder corn?

II. What is the cost per acre of gathering a crop of field corn, and preparing it for dairy food; and what is the cost per acre of ensilaging a crop of fodder corn?

III. What is the relative feeding value of the digestible food in corn meal, in dried stalks, and in corn ensilage?

IV. How much potash, phosphoric acid, and nitrogen is removed from an acre by a crop of field corn; and how much by a crop of fodder corn?

In 1883 a uniform field, upon the College Farm, was heavily manured, and prepared for corn in the usual manner.

Five and three-tenths acres were planted, for fodder only, in rows three feet apart. The yield from this area was 149,445 pounds; an average of fourteen and one-tenth tons per acre.

Ten and one-quarter acres were furrowed for field corn and planted in hills 3 ft. 6 in. apart each way.

The crop was cut up and shocked in the usual manner. After husking the entire product was weighed and found to average 68.3 bushels of *shelled corn*, and 2.2 tons of dried stalks, per acre.

I.

AMOUNT OF DIGESTIBLE FOOD PER ACRE.

1. *In a crop of field corn.*

2. *In a crop of ensilaged fodder corn.*

The term food embraces three distinct classes of chemical compounds, known as *Proteine*, *Fat* and *Carbhydrates*.

A description of these classes, and a discussion of the question of digestibility, supplemented by explanations of the methods of analyzing and comparing fodders and feeds, can be found upon page 102 of this Report.

1. *Digestible Food from one Acre in Field Corn.*

A very large proportion of the digestible food is to be found, of course, in the shelled corn. Nearly 40 per cent., however, of the total amount exists in the dried stalks; the cobs also contain a small but noticeable quantity.

SHELLED CORN.

On the 29th of January, 1884, the farm Superintendent shelled thirteen hundred pounds of ears, taken from the crop grown on the field under experiment.

The grain was thoroughly mixed and carefully sampled for analysis.

On the 14th of March a second sample was obtained in a similar manner, representing in this case sixteen hundred and eighty pounds of ears.

The average results of both analyses have furnished the basis for computing the amount of digestible food contained in the shelled corn from one acre.

DRIED STALKS.

Immediately after husking, two tons of dried stalks were cut and shredded in a Lion cutter and crusher, then packed into a silo and heavily weighted.

On the 29th of January, 1884, the silo was opened and ten bushels or more of the dried stalks taken out, thoroughly mixed, carefully sampled and analyzed.

On the 11th of March a second sample was secured in a similar manner. This represented the stalks in the lower half of the silo.

The average results of the analyses of both samples, furnish the data used in computing the amount of food in the dried stalks from one acre.

COBS.

The cobs from sixteen hundred and eighty pounds of ears, shelled March 14th, weighed three hundred and thirty-four pounds; nearly 20 per cent. of the total weight of the ears.

These cobs were also sampled and analyzed.

Of the following tables, the first gives the results of the analysis of the grain, stalks and cobs, together with their coefficients of digestibility; in the second table, these results have been recalculated and are expressed in pounds of digestible food with its value per acre.

CORN MEAL, CORN STALKS AND CORN COBS.

TABLE No. I.

PERCENTAGE, COMPOSITION, AND COEFFICIENTS OF DIGESTIBILITY.

	Corn Meal.		Dried Corn Stalks.		Corn Cobs.	
	Percentage.	Coefficient of Digestion.	Percentage.	Coefficient of Digestion.	Percentage.	Coefficient of Digestion.
Loss at 100°	16.17	....	10.66	....	17.20	....
Crude Fat	3.92	85	1.06	75	0.29	32
" Fiber	1.91	62	32.50	72	28.85	56
" Proteine	8.44	79	4.09	73	1.94	25
" Ash	1.55	....	4.80	....	1.33	....
Carbhydrates	67.58	91	46.89	67	50.89	36

TABLE No. II.

POUNDS AND VALUE OF DIGESTIBLE FOOD PER ACRE.

	Total Weight of Crop per Acre.	Pounds per Acre of Digestible.				Value per Acre of Digestible.				Total Value per Acre.
		Fat.	Fiber.	Proteine.	Carbhydrates.	Fat.	Fiber.	Proteine.	Carbhydrates.	
	Lbs.					@ 4⅓ per ℔	@ .9 per ℔	@ 4⅓ per ℔	@ .9 per ℔	
Corn Meal	3824.8	127.0	42.8	259.7	2368.7	$5.50	$0.39	$11.25	$21.32	$38.46
Dried Corn Stalks	4041.0	32.8	945.6	120.8	1269.7	1.40	8.51	5.24	11.43	26.58
Corn Cobs	950.0	0.9	150.9	4.7	174.0	0.40	1.36	0.20	1.57	3.17
Total	....	160.2	1139.3	385.2	3812.4	6.94	10.26	16.69	34.32	68.21

In this experiment, therefore, the digestible food from an acre in field corn consisted of 160 *pounds of fat,* 1,139 *pounds of fiber,* 385 *pounds of proteine and* 3,812 *pounds of carbhydrates, valued at* $68.21.

2. ***Digestible Food in Ensilage****, from the* ***Product*** *of* ***One Acre*** *in* ***Fodder Corn.***

The green stalks were cut up by hand, drawn to the barn and immediately weighed. They were then at once passed through a Ross cutter, driven by tread power, packed into a silo and heavily weighted.

The silo was opened on the 29th of January. After the decomposed material on the surface had been removed, an opening eighteen inches deep was made, and several bushels of ensilage removed. This was sub-sampled and prepared for analysis.

A duplicate sample was secured from another portion of the silo, on the 13th of February, 1884.

Each sample was analyzed separately and the averaged results used in subsequent computations.

QUANTITY AND VALUE OF THE DIGESTIBLE FOOD IN THE ENSILAGE FROM FOURTEEN TONS OF GREEN FODDER CORN.

	Per Centage Composition.	Coefficient of Digestibility.	Pounds per Acre of Digestible.	Value per Acre of Digestible.
Loss at 100° C.	71.31			
Crude Fat	0.31	75	70.5	$ 3.06
" Fiber	7.34	72	1452.3	13.07
" Proteine	1.72	73	313.0	13.56
" Ash	1.36			
Carbhydrates	17.96	67	3626.5	32.64
Total Value per Acre				62.33

In this experiment, therefore, the digestible food in the ensilage from 14.1 *tons of fodder corn consisted of* 71 *pounds of digestible fat,* 1,452 *pounds of fiber,* 313 *pounds of proteine,* 3,626 *pounds of carbhydrates, aggregating in value* $62.33.

The comparison between the yields and values of digestible food secured in crops of field and fodder corn can now be sharply drawn.

	Yield and Value per Acre of Digestible.				Value per Acre.	Total Yield of Crop per Acre.
	Fat.	Fiber.	Proteine.	Carbhydrates.		
	Lbs.	Lbs.	Lbs.	Lbs.		
Field Corn	160.2	1139.3	385.2	3812.4	$68.21	68.3 bu. Shelled Corn. 2.2 tons Dried Stalks.
Fodder Corn	70.5	1452.3	313.0	3626.5	62.33	14.1 tons Fodder Corn.

It is evident that, with the single exception of digestible fiber, the acre in field corn has surpassed that in fodder corn, both in the quantity and value of the digestible food produced.

II.

WHAT IS THE COST PER ACRE OF GATHERING A CROP OF FIELD CORN AND STALKS, AND PREPARING IT FOR DAIRY FOOD; AND WHAT IS THE COST PER ACRE OF ENSILAGING A CROP OF FODDER CORN?

An exact expense account was kept during the entire experiment.

In certain cases, however, it is necessary to state how charges were made; for instance, in cutting up the field corn, the expense amounted to $2.09 per acre. As 56 per cent. of the total weight of the crop lay in the ears, and 44 per cent. in the stalks, the expense was divided upon this basis.

The expense of husking and binding the stalks amounted to $5.58 per acre. It is claimed, in practice, that binding alone requires about two hours work out of ten; 80 per cent. of the total cost has, therefore, been charged to the ears and 20 per cent. to the stalks.

EXPENSES INCURRED IN GATHERING CROPS OF FIELD AND FODDER CORN, AND PREPARING THEM FOR DAIRY FOOD.

CORN MEAL.

Cost per Acre.

Cutting corn, $2.09; of which 56 per cent. is charged to corn meal	$ 1 17	
Husking corn, $5.58; of which 80 per cent. is charged to corn meal	4 46	
Teams and men hauling corn	2 00	
Team and men for shelling corn	1 50	
Team and man for hauling to and from the mill	2 00	
Grinding 3,824 pounds at one-tenth cent per pound	3 82	
		14 95

CORN STALKS.

Cost per Acre.

Cutting corn, $2.09; of which 44 per cent. is charged to corn stalks	92	
Husking corn, $5.58; of which 20 per cent. is charged to corn stalks	1 12	
Team and men for hauling stalks	77	
Labor of loading and stacking	95	
Team and men cutting and shredding stalks	4 00	
		7 76
Total cost for corn meal and corn stalks		$22 71

FODDER CORN.

Cost per Acre.

Cutting corn	$ 4 28	
Loading corn	3 42	
Teams for hauling to barn	8 23	
Horse power	1 98	
Labor at cutter	3 96	
Labor for packing in silo	3 54	
Labor weighting silo	1 00	
Total		$26 41

The comparison of the above accounts shows that the balance is clearly in favor of the field corn by at least FOURTEEN PER CENT.

A summary of the results thus far obtained allows the comparison between the field and fodder corn to be drawn upon a standard of dollars and cents.

	FIELD CORN.		Total from Field Corn.	Ensilage from Fodder Corn.
	Corn Meal and Corn Cobs.	Dried Field Corn Stalks.		
Value per Acre	$41.63	$26.58	$68.21	$62.33
Cost of Gathering and Preparing Product for Food	14.95	7.76	22.71	26.41
Balance to Cover Rent of Ground, Cost of Raising Crop, and Profits per Acre	26.68	18.82	45.50	35.92

By subtracting from the value of the product the expenses incurred in gathering and preserving it, a balance is obtained out of which must be paid the expenses of manuring, planting, cultivating, etc., as well as rent and profits.

In case of the field corn this balance is $45.50, *exceeding by* $9.59 *the balance from the ensilaged fodder corn.*

This assumes of course that the stalks are carefully utilized as food; if they are wasted, and corn meal is regarded as the only valuable product from field corn, the balance immediately changes to $9.24 in favor of the ensilaged fodder corn.

III.

WHAT IS THE RELATIVE FEEDING VALUE OF THE DIGESTIBLE FOOD IN CORN MEAL, IN DRIED FIELD CORN STALKS, AND IN CORN ENSILAGE ?

It has been claimed that in this experiment, the total value of the product from an acre in field corn was $68.21, while that from an acre in fodder corn was $62.33.

These figures were obtained by assuming that *digestible* proteine and fat were worth *four and one-third cents*, and *digestible* carbhydrates *nine-tenths of a cent* per pound, irrespective of the material from which they were derived; provided only that such material contained nothing injurious to animal life.

These prices, when applied to the digestible food in pure corn meal, make its value one dollar per hundred pounds, agreeing almost exactly with present market rates.

It remains now to show that these assumed prices are correct; that for milk production *digestible food* in dried stalks and in corn ensilage, is quite as valuable as that from corn meal.

Corn meal, corn stalks, and corn ensilage resemble each other in this respect, from 86 to 94 per cent. of their digestible food belongs to the class carbhydrates. *Clearly, therefore, the study of the feeding values of these materials is practically reduced to a comparative test of their carbhydrates.*

The examination of any ration, actually fed and admitted to be suitable for dairy herds will show that each cow consumes daily, approximately, three pounds of digestible proteine, and thirteen pounds of digestible carbhydrates including fat.

Such a ration cannot be made from either the meal, the dried stalks or the ensilage, used alone. The best effects of either of these materials will be seen when it is combined with products rich in proteine.

In the comparative feeding trials here reported, a mixture of thirty pounds of brewers' grains, and three pounds of oil meal, was selected to furnish the proteine and fat; it furnished also considerably less than one-half of the necessary carbhydrates, the balance being supplied in the different rations by the dried corn stalks, by a mixture of corn stalks and corn meal, and by corn ensilage as the following tabular statement shows:

ENSILAGE, CORN STALKS AND CORN MEAL.

Percentages of Digestible Food furnished by each in the following Rations.

POUNDS OF DIGESTIBLE	ENSILAGE RATION.			DRIED CORN STALK RATION.			CORN MEAL AND DRIED CORN STALK RATION.					
	Total Food in Ration.	Food from 40 lbs. of Corn Ensilage.	Percentage of Food furnished by 40 lbs. of Corn Ensilage.	Total Food in Ration.	Food from 12 lbs. of Dried Corn Stalks.	Percentage of Food furnished by 12 lbs. of Dried Corn Stalks.	Total Food in Ration.	Food from 5 lbs. of Corn Meal.	Food from 6 lbs. of Dried Corn Stalks.	Percentage of Food furnished by 5 lbs. of Corn Meal.	Percentage of Food furnished by 6 lbs. of Dried Corn Stalks.	Total Percentage in Corn Meal and Corn Stalks.
Fat	.67	.09	**13.4**	.68	.10	**14.7**	.80	.17	0.50	21.3	6.3	**27.5**
Proteine	2.85	.50	**17.5**	2.71	.36	**13.3**	2.86	.33	.18	11.5	6.3	**17.8**
Carbhydrates	11.92	6.92	**58.0**	11.58	6.58	**56.8**	11.36	3.07	3.29	**27.0**	**29.0**	**56.0**

COMPOSITION OF EXPERIMENTAL RATIONS.

POUNDS OF DIGESTIBLE	ENSILAGE RATION.			DRIED CORN STALK RATION.			CORN MEAL AND DRIED CORN STALK RATION.				BARN RATION.
	40 lbs. of Corn Ensilage.	30 lbs. of Brewers' Grains.	3 lbs. of Linseed Meal.	12 lbs. of Dried Corn Stalks.	30 lbs. of Brewers' Grains.	3 lbs. of Linseed Meal.	5 lbs. of Corn Meal.	6 lbs. of Dried Corn Stalks	30 lbs. of Brewers' Grains.	3 lbs. of Linseed Meal.	20 lbs. Brewers' Grains. 4.5 " Corn Meal. 3.2 " Cotton Seed Meal. 1.8 " Linseed Meal. 1.8 " Wheat Chaff. 10.0 " Corn Ensilage.
Fat	.09	.41	.17	.10	.41	.17	.17	.05	.41	.17	.97
Proteine	.50	1.44	.91	.36	1.44	.91	.33	.18	1.44	.91	3,51
Carbhydrates	6.92	4.01	.99	6.58	4.01	.99	3.07	3.29	4.01	.99	11.22

The aim of this feeding trial is to show that, for milk production, the digestible carbhydrates in field corn stalks and in corn ensilage are quite as valuable as those in corn meal.

For this purpose cows V and VI were fed a ration in which 57 per cent. of the carbhydrates were derived from *dried field corn stalks.* The average daily yield per cow, for fifteen days, was *twenty-five and two-tenths pounds of milk.*

During the next period of fifteen days the ration for cows V and VI was so changed that 29 per cent. of its carbhydrates were derived from *dried corn stalks*, and 27 per cent. from *corn meal.* The average daily yield of milk remained unchanged at *twenty-five and two-tenths pounds per cow.*

The digestible carbhydrates in corn meal and corn stalks, therefore, do not differ from each other in their effect upon the quantity of milk secreted.

In the ration for the third period, which embraced nearly five weeks, both corn meal and dried corn stalks were replaced by *corn ensilage.* During this period the average daily milk yield from cows V and VI was again practically unchanged—*twenty-five and one-tenth pounds per cow.*

The digestible carbhydrates in corn ensilage, therefore, can be substituted for those in corn meal and corn stalks without affecting the flow of milk.

This trial was repeated upon two other cows, numbers III and IV. For a period of five weeks their ration derived 29 per cent. of its carbhydrates from dried corn stalks, and 27 per cent. from corn meal. The average daily yield of milk was *twenty-three and seven-tenths* pounds per cow.

In the next period of six weeks, corn ensilage replaced both the corn meal and corn stalks.

The average daily yield of milk from cows III and IV upon this ration was *twenty-three and two-tenths pounds.* Compared with the previous record, it shows a daily decrease of one half-pint only per cow.

This second trial, therefore, substantiated the conclusions already reached.

Details are tabulated below. Black faced type have been used to aid in comparing the yield from the same herd when fed upon different rations.

RATION.	Number of Cow.	Milk Yield per Day in Pounds for Periods with Different Rations.						
		Jan. 17 thro' Jan. 31	Feb. 1 thro' Feb. 15	Feb. 16 thro' Mar. 3.	Mar. 4 thro' Mar. 22	Mar. 23 thro' Apr. 16	Apr. 17 thro' May 7.	May 8 thro' June 3.
Barn. 29 lbs. Brewers' Grains. 4.5 " Corn Meal. 3.2 " Cotton Seed Meal. 1.3 " Linseed Meal. 1.8 " Wheat Chaff. 10.0 " Corn Ensilage.	V	33.0						
	VI	29.8						
	Average	31.4						
Corn Stalk. 12 lbs. Dried Stalks. 30 " Brewers' Grains. 3 " Linseed Meal.	V	....	27.2					
	VI	....	23.2					
	Average	....	25.2					
Corn Meal and Corn Stalks. 5 lbs. Corn Meal. 6 " Dried Stalks. 30 " Brewers' Grains. 3 " Linseed Meal.	V	....	....	27.4				
	VI	......	....	23.0				
	Average	....	....	25.2				
	III	....	....	27.8	28.5			
	IV	....	....	18.4	20.1			
	Average	....	....	23.1	24.3			
				23.7				
Corn Ensilage. 40 lbs. Ensilage. 30 " Brewers' Grains. 3 " Linseed Meal.	V	....	....	....	26.0	28.5		
	VI	....	....	....	22.3	23.3		
	Average	....	....	....	24.2	25.9		
					25.1			
	III	....	....	....	....	26.6	26.0	
	IV	....	....	....	....	19.7	20.2	
	Average	....	....	....	....	23.2	23.1	
						23.2		
Corn Ensilage. 40 lbs. Ensilage. 30 " Brewers' Grains. 3 " Linseed Meal.	V	....	....	....	....	....	....	25.5
	VI	....	....	....	....	....	....	23.2
	Average	....	....	....	....	....	....	24.4
	III	....	....	....	....	....	....	25.0
	IV	....	....	....	....	....	....	20.0
	Average	....	....	....	....	....	....	22.5
Barn........................	Average of Eight Cows.			20.0	19.7	19.7	19.8	19.9

From these results the conclusions can be fairly drawn that, *for milk production, the digestible carbhydrates from corn meal, corn stalks and corn ensilage can replace each other without affecting the quantity of the product; consequently, they are, for this purpose, of equal value.*

Two possible sources of errors affecting this conclusion were recognized when the experiment was planned.

1. The station's ration may have contained a large excess of digestible food; in which case the substitution of corn meal for indigestible and worthless material might have been without effect upon the milk yield.

2. Other conditions, temperature, weather and so forth, may have exerted a favorable influence in increasing the yield from an inferior ration.

The first point was checked by noting the milk yield from cows V and VI while they were fed upon the "barn ration." The average daily yield for fifteen consecutive days was then *thirty-one and four-tenths pounds per cow.* This yield immediately fell when these two cows were fed the corn stalk ration, the average for fifteen consecutive days being then only *twenty-five and two-tenths* pounds per cow, a decrease of 20 per cent., which, however, is easily understood when it is seen that the corn stalk ration contained 23 per cent. less proteine, and 29 per cent. less fat than the "barn ration."

This comparison indicates clearly that the station's rations did not contain an excess of digestible proteine and fat, for it is positively shown that an increased milk yield of 20 per cent. resulted from an increased consumption of these compounds.

The carbhydrates in the station's rations agree substantially with the quantities dictated by practice, ranging from eleven and four-tenths to eleven and nine-tenths pounds per cow; from four to eight per cent. less than German feeding standards demand.

Regarding the second point, viz: that the yields of milk might have been favorably influenced by unknown conditions, but little need be said; as a check upon such possibilities, eight cows, fed upon the barn ration, without changes, for one hundred and nine consecutive days, prove by the regularity of their milk flow that they at no time were affected by such influences, consequently it is safe to assume that the experimental cows in the same barn were also unaffected.

The milk record of these eight cows is included in the last table.

IV.

HOW MUCH POTASH, PHOSPHORIC ACID AND NITROGEN IS REMOVED FROM AN ACRE BY A CROP OF FIELD CORN, AND HOW MUCH BY A CROP OF FODDER CORN?

The determinations of *nitrogen*, *phosphoric acid* and *potash* were made in the samples of ensilage, also in those of the corn meal, corn stalks and corn cobs, secured in duplicate as has been already described.

The total weights of nitrogen in the crops do not differ materially from each other, being eighty-two pounds in the field corn, and seventy-nine pounds in the fodder corn.

The same close agreement also exists in the case of phosphoric acid; forty-five pounds being found in the field corn, and forty-two and one-half pounds in the fodder corn.

The only noticeable difference occurs in the relative amounts of potash, the fodder corn utilizing eighty-five pounds, and the field corn fifty-three and five-tenths pounds.

The total value of the plant food in each crop at present market rates, shows a remarkable agreement; that from the fodder corn being $21.94, and that from the field corn $21.34 per acre.

Practically, therefore, there would be no difference in the expense of replacing the plant food removed by each crop.

The details are tabulated as follows :

Quantity and Value of Plant Food, Removed per Acre, by Crops of Field and Fodder Corn.

	Total Yield per Acre.	Percentage of			Pounds per Acre of			Value per Acre of			Total Value.
		Green Fodder Corn.									
		Nitrogen.	Phos. Acid.	Potash.	Nitrogen.	Phos. Acid.	Potash.	Nitrogen.	Phos. Acid.	Potash.	
Fodder Corn.........	lbs. 28,200	0.28	0.15	0.30	79.0	42.3	84.6	$15.80	$2.54	$3.60	$21.94
		Field Corn.									
		Nitrogen.	Phos. Acid.	Potash.	Nitrogen.	Phos. Acid.	Potash.	Nitrogen.	Phos. Acid.	Potash.	Total Value.
Shelled Corn	lbs.3824	1.38	0.71	0.40	52.7	27.2	15.3	$10.54	$1.63	$0.65	$12.82
Dried Stalks	" 4041	0.65	0.37	0.82	26.3	15.0	33.1	5.26	.90	1.41	7.57
Cobs	" 950	0.31	0.27	0.50	2.9	2.6	4.8	0.58	.16	.21	.95
Total..........					81.9	44.8	53.4	$16.38	$2.69	$2.27	$21.34

CONCLUSIONS.

The aim of the above work was to compare field corn and fodder corn; regarded simply as sources of winter food for dairies.

It has been shown that large areas of land, under identical conditions as regards manure, soil and season, averaged per acre sixty-eight and three-tenths bushels of *shelled corn*, and *two* and *two-tenths tons* of *dried stalks*, against *fourteen* and *one-tenth* tons of *green fodder corn.*

A comparative feeding trial has shown that in *quality* the digestible food secured in corn meal, corn stalks and fodder corn is of equal value for milk production. It has also been shown that as regards the expense of replacing the plant food removed from the fields, no practical difference exists between the crops.

In quantity of digestible food and expense incurred in gathering and preserving it, the balance is, however, at present, decidedly in favor of the field corn.

SORGHUM ENSILAGE.

The past year's experiments upon this subject include:

I. Determinations of the quantity of food at present unavoidably lost when sorghum is ensilaged.

II. A comparison between sorghum ensilage and corn ensilage, used in rations for milch cows.

I.

LOSSES OF FOOD IN SILOS.

The method used for detecting such losses is as follows:

On the 15th of October, 1884, a section of the College Farm silo was filled with twenty tons of amber cane.

During this work small portions of the finely cut sorghum were from time to time taken with a scoop shovel from the constantly changing pile below the cutter.

One-half of each portion was stamped into a clean, dry oil barrel, while the other half was placed in baskets; later the contents of the baskets were mixed and sub-sampled. These samples it is claimed fairly represent the sorghum used in this experiment. When the barrel was quite full, it was headed up and removed to a cold underground room in the laboratory building, where two small iron tubes were passed through its head.

One of these tubes, provided at the upper end with a T, served two purposes; through one opening the gas generated by fermentation was conducted into solutions arranged to absorb it; to the other opening a mercury gauge was attached; this acted both as a pressure indicator and also as a safety valve.

The other tube which also passed through the head was capped air tight at its lower end and forced down through the sorghum nearly to the bottom of the barrel. This tube served as a receptacle into which a thermometer could be easily dropped, for approximately determining temperatures at the centre of the ensilage.

By attaching a pressure pump to the gas delivery tube, described above, all leaks were detected and stopped with white lead or putty. The barrel was then severely tested up to twelve inches mercury pressure per square inch of surface.

The night of the fourteenth of October was frosty and the temperature during the following day did not rise very much above the freezing point, the weather, therefore, was favorable both for filling silos and securing samples.

During the first forty-eight hours there was no evolution of gas. The temperature of the ensilage slowly rose to that of the surrounding air, until the 18th of October, when the thermometers inside and outside of the barrel registered 13° C.

The evolution of carbonic acid gas then began and continued three days; upon the fourth day, Oct. 22nd, it ceased entirely, and from that time until the close of the experiment, Dec. 1st, the temperature of the ensilage was governed by that of the room, at no time exceeding 15° C.

The carbonic acid gas evolved, weighed forty-three grammes only; the sulphuric acid drying bottle through which this gas was passed remained constant in weight, showing that no moisture escaped from the ensilage through this channel.

The green sorghum packed into the barrel weighed *two hundred and twenty pounds.*

The ensilage removed from the barrel also weighed nearly two hundred and twenty pounds. Its exact weight, however, could not be determined as the scales did not read closer than half pounds.

The loss in weight due to fermentation amounted therefore to less than one quarter of one per cent.

This ensilage was found but little altered in appearance; in taste however, it was decidedly but not unpleasantly acid; noticeably different from many samples of corn ensilage.

A determination in duplicate made by repeatedly diffusing weighed portions of material in cold water, and neutralizing the acid extract with standard alkali, indicated that one hundred pounds of ensilage contained acids equivalent to fifty-seven one hundredths of a pound of lactic acid.

ANALYSIS OF GREEN SORGHUM AND OF SORGHUM ENSILAGE.

The green sorghum was sampled as described above.

The ensilage was entirely removed from the barrel, thoroughly mixed, spread over a clean floor and about twenty pounds rapidly taken from different portions of the layer.

From this quantity of twenty pounds, duplicate samples were drawn and dried for analysis.

The results are as follows:

	Green Sorghum. packed in barrel.	Sorghum Ensilage from barrel.
Loss at 100° C.	71.50	71.94
Crude Fat,	0.18	0.14
Crude Fiber,	6.95	6.79
Crude Proteine,	0.95	0.92
Crude Ash,	1.04	1.08
Carbhydrates,	19.38	19.13
	100.00	100.00

The analyses indicate that but slight changes had taken place after the sorghum was packed away; corroborating the direct weighing given above, which showed a loss in weight of less than one quarter of one per cent.

The true nature of the changes which occurred can however be seen from the following table in which the absolute amount of food packed into the barrel as green sorghum, can be compared with that removed from it in the form of ensilage.

As there was no way known in which water could escape from the barrel the calculations are based upon the supposition that the percentage of moisture remained constant.

	Green Sorghum. Pounds.	Sorghum Ensilage. Pounds.
Moisture	157.30	157.30
Crude Fat	0.40	0.31
Crude Fiber	15.29	14.93
Crude Proteine	2.09	2.02
Crude Ash	2.29	2.38
Carbhydrates	42.64	42.09
	220.01 lbs.	219.03 lbs.
Forty-four hundredths per cent. of solids changed into volatile compounds		.97 "
		220.00 lbs.

The comparison shows that the noticeable changes occurred in the fiber and carbhydrates; forty-four hundredths per cent., or ninety-seven hundredths of a pound of these materials having been changed into lactic acid or some similar volatile compound.

This was driven off in the process of drying the sample for analysis, as is indicated in the first of the above tables of analysis, under "loss at 100° C."

The feeding value of such volatile compounds is not known.

The conclusions reached are:

I. *Sorghum can be preserved in silos with practically no loss of weight.*

II. *Fermentation appears to affect carbhydrates alone. With absolute exclusion of air such fermentation apparently ends within the first four days, and involves less than one per cent. of the total weight of the sorghum.*

II.

COMPARATIVE FEEDING TRIAL OF CORN ENSILAGE AND SORGHUM ENSILAGE.

The cows used in this trial had been fed for more than six weeks upon a ration composed largely of *corn ensilage.*

They were consequently accustomed to its acid taste, and no noticeable decrease in milk yield or disturbance in their health was caused by the change from one kind of ensilage to the other.

Sorghum and corn are both sources principally of carbhydrates, and for this reason cannot be economically used as animal food, unless combined with materials rich in proteine and fat.

In detail the rations fed in this experiment were as follows:

Sorghum Ensilage Ration.

	42 pounds of Sorghum Ensilage, Sample No. 173.	90 pounds of Brewers' Grains, Sample No. 167.	4 pounds of Linseed Meal, Sample No. 163.	Total Food in Ration.	Food furnished by 42 pounds of Sorghum Ensilage.	Percentage of Food furnished by Ensilage.
Pounds of Digestible Fat	.16	.41	.22	.79	.16	**20.00**
Pounds of Digestible Proteine	.17	1.44	1.21	2.82	.17	**6.00**
Pounds of Digestible Carbhydrates	6.08	4.01	1.32	11.41	6.08	**53.60**

Corn Ensilage Ration.

	40 pounds of Corn Ensilage, Samples No. 170, 173.	30 pounds of Brewers' Grains, Sample No. 167.	8 pounds of Linseed Meal, Sample No. 168.	Total Food in Ration.	Food furnished by 40 pounds of Corn Ensilage.	Percentage of Food furnished by Ensilage.
Pounds of Digestible Fat	.09	.41	.17	.67	.09	**13.4**
Pounds of Digestible Proteine	.50	1.44	.91	2.85	.50	**17.5**
Pounds of Digestible Carbhydrates	6.92	4.01	.99	11.92	6.92	**58.0**

The proteine and fat, as these tables show, were in both cases largely furnished by brewers' grains and oil meal.

This is particularly true of the sorghum, which is so much poorer than corn in proteine that an additional pound of oil meal was required in order to bring its ration up to standard.

Of the carbhydrates, sorghum ensilage furnished 53 per cent., and corn ensilage 58 per cent. of the total amounts fed in each case.

This experiment, therefore, may be regarded practically as a comparison of the feeding values of the carbhydrates in sorghum and corn.

Cows V and VI were fed upon the *corn ensilage ration* from March 23rd until April 16th, twenty-four days.

The average daily yield of milk per cow was *twenty-five and nine-tenths pounds.*

From April 16th until May 7th, twenty-two days, cows V and VI were fed upon the *sorghum ensilage ration.*

The average daily yield of milk was *twenty-five and seven-tenths pounds per cow.*

Practically, therefore, digestible carbhydrates of corn and sorghum ensilage, can be substituted for each other in a cow's ration without affecting the flow of milk.

PRESERVATION OF SORGHUM IN STACKS.

The Superintendent of the College Farm, independent of the Station, stacked about two tons of ripe amber cane, to test this method of preservation.

As this cane was cut immediately after the first heavy frost, and as the weather remained uniformly cool, the conditions are admitted to have been unusually favorable.

The sorghum was cut and stacked October 15th; one month later, Nov. 15th, it was found to be practically unchanged, being then as juicy and sweet as fresh cane.

A sample for analysis was secured by cutting up 370 pounds in a Lion cutter and crusher; mixing it thoroughly and removing about fifteen pounds from different portions of the pile. The analysis is given below, compared with that of a sample of fresh sorghum secured Oct. 15th, the date on which the stacks were made.

	Ripe Sorghum sampled Oct. 14.	Ripe Sorghum cut and stacked Oct. 14, sampled Nov. 14.
Loss at 100° C.	71.50	61.59
Crude Fat	0.18	0.31
Crude Fiber	6.95	8.49
Crude Proteine	0.95	1.33
Crude Ash	1.04	1.24
Carbhydrates	19.38	27.04

By combining the *fiber and carbhydrates* in each sample, and calculating the sorghum from the stacks, upon the original moisture basis, the comparison indicates that little if any loss of food was caused by the month's exposure to the weather. This is evident from the following table:

	Ripe Sorghum, sampled Oct. 14.	Ripe Sorghum, cut and stacked Oct. 14, sampled Nov. 14.
Loss at 100° C.	71.50	71.50
Crude Fat,	0.18	0.23
Crude Proteine,	0.95	0.99
Crude Ash,	1.04	0.92
Carbhydrates,	26.33	26.35
	100.00	99.99

One-half of the stacked sorghum was fed Nov. 15, and was clearly preferred by the cows to ensilage which had been stored upon the 15th of Oct.

The other half was allowed to remain still longer in the stacks, but when inspected about the first of December, it was found to be sour and rapidly becoming worthless.

For immediate use, therefore, stacked sorghum may be superior to sorghum ensilage.

But if kept longer than four or five weeks, rapid fermentation and loss of food must be expected.

THE DAIRY BUSINESS FINANCIALLY CONSIDERED.

On the 17th January, 1884, an experienced man was engaged by the station to weigh daily all feed and fodder consumed by the milch cows in the College Farm barn. It was also this man's duty to weigh the milk from each cow separately, and to send the daily record of his work to the Station's Laboratory.

This record was closed upon June 3rd; it embraced, therefore, a period of *one hundred and thirty-nine days.*

The ton prices of the food consumed and the expenses for labor, etc., incurred in producing and marketing milk, have been taken from the farm's account book; reliable data are, therefore, available for showing:

I. The cost per quart of producing and retailing milk.

II. The possible changes in management, by which expenses may be diminished.

These records have been tabulated, condensed and prepared for this Report at a very considerable outlay of time and labor, but as certain points involved have not yet been definitely settled, it has been deemed advisable to delay publication for the present, and use the material in a forthcoming bulletin.

PEACH TREES AND THE YELLOWS.

The great value of the peach crop, and the damages from the early failure of the trees caused by the "yellows" is attracting increased attention, and calling for intelligent inquiry for the means of its prevention. Dr. C. A. Goessmann, of the Massachusetts Agricultural College, at Amherst, in 1878 engaged in investigations to answer these inquiries. He began by treating diseased trees, on his own grounds, with phosphatic manures and muriate of potash. The trees so treated were restored to a healthy condition and have continued to bear good crops of healthy fruit ever since. He analyzed the wood and the fruit of healthy and diseased trees with the following results:

Fruit of Crawford's Early.	**Healthy.**	**Diseased.**
Peroxide of iron	**0.59**	**0.46**
Lime	**2.64**	**4.68**
Magnesia	**6.29**	**5.49**
Phosphoric Acid	**16.02**	**18.07**
Potash	**74.46**	**71.30**
	100.00	**100.00**

Branches of Crawford's Early.	**Restored.**	**Diseased.**
Peroxide of iron	**0.52**	**1.45**
Lime	**54.52**	**64.23**
Magnesia	**7.58**	**10.28**
Phosphoric acid	**11.87**	**8.37**
Potash	**26.01**	**15.67**
	100.00	**100.00**

In Prof. Penhallow's Houghton Farm papers, Series 3, No. 2, he says, in regard to the above analyses: "It should be remarked here, that the tree marked restored, was one which had been brought into a thoroughly healthy condition from a badly diseased state. These analyses show but little variation in the magnesia, somewhat more in the phosphoric acid and oxide of iron and a most striking relation between the lime and potash. In fact, this relation is reciprocal and shows that while the former increases in the diseased structure, and decreases in the healthy, the latter increases in the healthy and decreases in the diseased. So far as the lime is concerned, its relation to a diseased condition, as shown here, is curiously parallel with its presence in the form of oxalate in the bark of many trees, and the relations which it bears to the storage of starch. A very important influence is to be attributed to the action of chlorine. While potash appears to influence the formation of starch, chlorine seems to be essential for its normal distribution to various parts of the plants where it is demanded by the requirements of growth. This is the conclusion to be derived from experiments both past and present, for it is found that, in certain cases at least, the sulphate of potash is not efficacious, and the restoration of the diseased structure to a normal condition is only brought about by the chloride."

Prof. Penhallow discussed in the above mentioned publication the characteristics of the disease and the treatment necessary for overcoming it. He " finds its origin in conditions of special soil exhaustion, and that a rational course of treatment will be directed towards supplying the wants here manifested."

His directions are:

I. Avoid the undue application of stable manures. If necessary to use them, have them well composted.

II. If the tree is already badly diseased, trim back all the branches showing wiry twigs, the object being to remove as much of the diseased structure as possible without killing the tree.

III. Cultivate the tree as you would any other crop that requires careful attention, and from which you expect to get paying returns.

IV. Apply commercial fertilizers of the following mixture:—

Kieserite (Sulphate of Magnesia), ...	25 pounds.
Muriate of Potash, ...	100 to 150 pounds.
Dissolved Bone Black, ...	450 pounds.

This is the proper quantity for an acre, which, allowing 70 to 100 trees to the acre, will give about 6 to 9 pounds to the tree. This will furnish a complete manure, and ensure a general building up of the entire system.

If the trees are in an advanced stage of the disease, add more muriate of potash, giving about four pounds of this salt to a tree of average size and age. Apply in the spring before growth commences, and repeat in the fall.

To apply the fertilizers, spade the ground as far as the roots extend. Mulch with the inverted sods or with straw, and apply the fertilizer to this, leaving a space of one foot all about the tree. The object of the mulch is to prevent too sudden contact with the roots. If this occurs the strong fertilizers will be apt to cause injury."

Various reports have been received as to the beneficial effects of Muriate of Potash, both with and without other commercial fertilizers, upon growing peach trees. To give more precision to our information on this subject, Mr. J. M. White, an intelligent and successful fruit grower, was sent by the Station to inquire into the practice of some of the best peach growers in Hunterdon and Morris Counties. He reports as follows:

PROF. GEO. H. COOK, Director, &c.,

Dear Sir :—In passing through Hunterdon and Morris Counties, I found among peach growers that it was their general practice to prepare the soil for setting trees about the same as for planting corn. Corn is planted among the trees the first two seasons, and then buckwheat for one or two seasons, and under this treatment with good soil the majority seem to be fairly successful. The orchards are expected to survive six to eight years. Those however, who have the healthiest orchards and make the most money do not crop their orchards more than the first season if at all. The soil best suited for the Peach seems in those localities to be clay or loam. I found some with orchards on naturally good soil who had obtained fair crops without fertilizers, but those who have been most successful have used either wood ashes or Muriate of Potash.

S. K. Everett, of Cherryville, Hunterdon County, has 3,500 bearing trees, all in good condition and almost free from "Yellows." He has used for four years in succession Muriate of Potash and Mapes' best bone, 4 pounds potash to 6 pounds bone, drilled at the rate of 300 and 350 pounds per acre.

For the four years he has realized $900 per acre. All his neighbors give him the credit of having the best fruit in the vicinity. His soil is a clay loam. He plants on a clover sod, prepared same as for corn, setting trees 17 to 18 feet apart; does not crop his orchard.

Jacob R. Werts, Mr. Everett's neighbor, follows his example, with about the same results. Mr. Everett endeavors to train the trees, during the first two years, so that they will not require much trimming afterward. Mr. Everett's trees are about eight years old; surface of ground slightly inclining.

Julius Johnson, of Quakertown, a very successful grower, uses only wood ashes and stable manure; plants no crops in his orchards, and cultivates thoroughly, mostly with spring-tooth harrow; has this season cultivated 15 to 17 times. He has little, if any "Yellows," but takes the greatest care to guard against the disease, removing all trees on the first appearance of disease. He has a young orchard of 1,100 trees, the finest I ever saw. The trees in this orchard were grown by planting the pits where the trees were to stand; the pits being planted in the Spring and budded the following Fall. Mr. Johnson selected pits from trees of natural fruit in his own orchard, taking great care the trees were perfectly healthy; selected buds also with the same care, and the result is fine, healthy trees. Wood ashes the only fertilizer used on this orchard. He gathered 70 baskets of fruit from this orchard at two years old.

He has an orchard of 2,400 trees on 15 acres, 12 years old, on clay soil, from which he has netted $18,000, all expenses having been deducted, except his own labor.

Mr. Johnson says: "I have never had wood ashes enough to spread broadcast over any very large part of my peach orchard, but would like to have enough so as to apply about 50 or 75 bushels to the acre. A smaller amount than this will do a great deal of good. My mode has been to spread it around and under the trees, about as far as the branches extend, for one and two-year old trees. Two or three quarts to the tree gives them a fine start, and will green them up wonderfully. I apply more as the trees grow older. I believe every young orchard should be thus treated, if the amount necessary to spread broadcast cannot be obtained."

John T. Starr, of Quakertown, has used Coe's and Mapes' fertilizers three years with fair success. His land is a sandy loam with clay bottom. Applies 300 @ 400 lbs. per acre of the fertilizer.

Dr. Henry Race, of Pittstown, has an orchard of 3000 bearing trees on sandy loam with clay subsoil, on which he has used muriate of potash in connection with Elizabeth Glue Company's phosphate three years with good results, has used common salt and Kainite with same results. Applies sulphate potash about base of trees to prevent the grub. Uses clover sod.

W. J. Case, of Pittstown, has an orchard of 11 acres on yellow clay soil which was set out in 1874. The trees bore no fruit worth mentioning until 1879, and have had a fair crop every year since, amounting in the six years to 13,983 baskets, which netted $11,368. Has used on the orchard every year since bearing about 400 lbs. of ground bone to the acre, except the last season, when he used phosphate.

John Stiles of New Vernon, has about 51 acres bearing trees and has used Lister's bone and wood ashes with good results, approves of clean cultivation, good feeding, and no cropping the orchard, would not use green yard manure, prepares ground the same as for a good corn crop, his soil is a stone iron with clay subsoil. Uses clover sod.

Yours Respectfully,

J. M. White.

Mr. White is himself a successful grower of peaches and the following account of his work is added:

He has an orchard of about 500 trees which are now 12 years old, and while young were not well treated, being fertilized very little and not properly cultivated. In the spring of 1882 they were looking badly, and he resolved to treat them with an application of green poudrette, 300 bushels per acre. He carefully cultivated the orchard, freeing the trees from all borers. That season he gathered about 450 baskets of fine peaches. In 1883 they were looking well, and he applied 3 lbs. of Mapes' Peach Manure to each tree, using the same care in cultivation, but thinks he did not thin the fruit sufficiently as he gathered 900 baskets of rather small fruit. In 1884 he applied 2 lbs. of Muriate of Potash, and 4 lbs. of Dissolved Boneblack to each tree, and gathered 700 baskets of fine fruit. The trees are now looking well, and he considers the prospect for fruit so promising that he will try the same treatment for the coming season.

He has another orchard of 375 trees, six years old, which have borne a fair crop for the last three years. This orchard has always had good cultivation and been fairly fertilized, but the first three years with stable manure. In 1882 he used three lbs. of Mapes' Peach Manure to each tree and gathered 250 baskets of very fine fruit. In 1883 he used stable manure, and gathered 850 baskets of poor fruit, due, he thinks, to the want of being more properly thinned. In 1884 he used Muriate of Potash and Bone Black, the same amount and proportion as on the older orchard, except in a few instances where he applied green poudrette. He gathered 650 baskets of good fruit, being the most satisfactory where the Potash and Bone were used. One half of the orchard is set with the Temple White peach which he considers nearly worthless; the larger part of his crop always comes from the other half of the orchard. His experience has been that the Temple White tree grows well, but the fruit cracks and rots before ripening.

One valuable lesson may be taken from the preceding statements:

That fertilizers, especially mineral fertilizers, are quite as useful upon growing peach trees as they are on annual farm crops.

That muriate of potash is especially adapted to promote the growth of peach trees, and to prevent the "yellows," is not so clearly proved, though the trials with it are encouraging.

[*From the Annual Report of the Connecticut Agricultural Experiment Station for 1884.*]

ANALYSES OF THE ASH OF HEALTHY AND DISEASED PEACH WOOD.

P. M. Augur, Esq., the State Pomologist, recently sent to the Station for examination two samples of wood marked,

I. "From Mt. Rose peach tree supposed to be healthy."

II. "From diseased Mt. Rose peach tree."

The disease from which II was suffering was stated to be the "Yellows."

For analysis twigs of equal size were selected from the two lots.

They were about $\frac{5}{16}$ inch diameter at the butt end and $\frac{3}{16}$ to $\frac{4}{16}$ inch diameter at the tip and were of last year's growth.

The pure ash of I (carbonic acid, coal and water excluded) amounted to 1.87 per cent. The pure ash of II amounted to 1.61 per cent. The analyses of 100 parts of the ashes are as follows:—

	I. *Healthy.*	II. *Diseased.*
Silica and matters insoluble in acid	5.38	9.47
Oxide of iron	1.09	2.09
Lime	54.20	54.05
Magnesia	9.49	7.49
Potash	16.31	13.95
Soda	1.18	1.19
Phosphoric acid	4.34	4.68
Sulphuric acid	6.90	6.53
Chlorine	.46	.48
	99.35	99.88

In comparing the above analyses we note that the ash of diseased twigs contains:—

4.09 per cent. more silica, etc.,
1.00 per cent. more oxide of iron,
.34 per cent. more phosphoric acid,
.15 per cent. less lime,
2.00 per cent. less magnesia,
2.36 per cent. less potash and
.37 per cent. less sulphuric acid

than the ash of healthy twigs.

Dr. Goessmann, in his analyses of Crawford's Early Peach,* reported in the ash of branches diseased by Yellows

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* Paper read before Mass. Hort. Society, March 18, 1882.

0.93 per cent. more oxide of iron,
9.71 per cent. more lime,
2.70 per cent. more magnesia,
3.00 per cent. less phosphoric acid and
10.34 per cent. less potash

than in ash of healthy branches, taken from a once slightly affected tree which had been restored by treating (for three years?) "with a phosphatic fertilizer in the usual proportion, adding at the same time from three to four pounds of muriate of potash for every tree, the diseased branches," at the outset, having been "cut back to healthy wood." Dr. Goessmann infers that "the diseased objects (wood and fruit) contain less potash and more lime than the healthy ones."

Dr. Goessmann leaves out of the account the items, Silica and matters insoluble in acid, Soda, Sulphuric acid and Chlorine, which in the above analyses amount to 13.92 per cent. of the ash of the healthy twigs and 17.62 per cent. of the ash of the diseased twigs. To omit those would somewhat increase the differences between the ash of the two, and would make lime in the ash of diseased twigs 3 per cent. more than in the healthy ones.

A more correct comparison is that of the absolute quantities of the several ash-ingredients contained in the same amount of the fresh twigs, as follows:—

In 10,000 parts of the peach twigs from Mr. Augur there are;

	Healthy.	*Diseased.*
Silica and insoluble	10.07	15.25
Oxide of iron	2.04	3.36
Lime	101.44	86.99
Magnesia	17.75	12.05
Potash	30.55	22.45
Soda	2.20	1.91
Phosphoric acid	8.14	7.53
Sulphuric acid	12.91	10.51
Chlorine	0.87	0.70
	185.97	160.75

Here it becomes manifest that in the peach wood here examined 10,000 pounds of diseased twigs contain

5.2 pounds more silica,
1.3 pounds more oxide of iron,
14.5 pounds less lime,
5.7 pounds less magnesia,
8.1 pounds less potash,
0.3 pounds less soda,
0.6 pounds less phosphoric acid,
2.4 pounds less sulphuric acid and
.2 pounds less chlorine

than the healthy twigs. The diseased twigs in this case thus manifest, as compared with the healthy ones, a *poverty of all the ash-ingredients*, the first two alone excepted.

The ingredients most largely deficient, and those therefore whose supply to the soil by way of fertilizing applications is most imperative, are lime, potash, magnesia and sulphuric acid.

To judge from the relative quantities of the deficient ingredients, the application of lime and magnesia in the case of Mr. Augur's peach orchard is as essential to the production of healthy wood and fruit as the addition of potash, and more necessary than the application of a phosphatic fertilizer.

The investigations of Drs. Goessmann and Penhallow indicate that chlorine, though present in wood in very small quantity, is yet important in the foliage as a means of assisting the transfer of nutritive matters from the leaves to the fruit and buds, and therefore must not be deficient in the soil, although evidently no large amount is needful.

MISCELLANEOUS.

I. Methods for Milk Analyses.
II. Corn and Cob Meal.
III. Formulas for mixing Fertilizers.

I.

METHODS FOR MILK ANALYSES.

In the Report for 1883, pages 86–91, a series of milk analyses was given.

It was from samples authenticated and sent to the Station by the Hon. I. W. Nicholson, of Camden.

Monthly trials were made of the percentage of total solids in milk from each of twelve dairies. These were continued through the whole year, and the results represent the average for 230 cows.

The herds averaged 19 cows each; the largest contained 36, and the smallest 7.

In all, 140 trials were made, and the average of all for the whole year was 12.99 per cent. of total solids.

The highest percentage found was 15.47, and the lowest was 11.67.

Of the 140 samples, 6 fell below the lawful standard of 12 per cent., though at most by only one-third of one per cent.

The method of analysis followed was that known as Heidlen's process.

Some criticisms having been made in Germany previous to 1883, upon the acuracy of this method, Dr. Schmoeger, of the Experiment Station at Proskau in Silesia, re-examined and compared it with the most approved processes for determining total solids in milk.

The station at which this was done is devoted almost entirely to investigating the production and utilization of milk.

The results of his examinations are published in Dr. E. F. W. Pflüger's Archiv für die Gesammte Physiologie, Vol. 31, Bonn, 1883.

DR. SCHMOEGER'S EXAMINATION OF HEIDLEN'S METHOD OF DETERMINING MILK SOLIDS.

In brief this method is

I. To absorb a weighed quantity of milk in a weighed quantity of washed, sifted and ignited sand.

II. To dry this mixture of milk and sand at water bath temperature, until constant weight is obtained.

Dr. Schmoeger's work included—

1. A large number of duplicate determinations by Heidlen's method;—an answer to the criticism that its results upon the same sample were variable.

2. A comparison of Heidlen's method with the Standard Hydrogen method and with the alcohol and the acetic acid process.

I.

Twelve determinations in duplicate by Heidlen's method gave the following results:

No. 1	12.14 per cent.	12.09 per cent.
" 2	12.30 "	12.32 "
" 3	11.64 "	11.66 "
" 4	10.50 "	10.50 "
" 5	11.48 "	11.47 "
" 6	11.35 "	11.37 "
" 7	11.89 "	11.89 "
" 8	11.70 "	11.71 "
" 9	9.48 "	9.49 "
" 10	9.31 "	9.32 "
" 11	9.24 "	9.21 "
" 12	11.44 "	11.46 "

These results prove that in skillful hands Heidlen's method does not give variable results.

2.

COMPARATIVE RESULTS WITH DIFFERENT METHODS.

1. Comparative results obtained by Heidlen's method, and by the standard hydrogen method.

	HYDROGEN. Per cent.	HEIDLEN'S. Per cent.
With first milk drawn from the udder	9.56 — 9.52	9.62 — 9.64
" last " " " " "	13.13 — 13.12	13.22 — 13.21

Heidlen's method gives results about 0.1 per cent. higher than the hydrogen method.

2. Comparative results obtained by Heidlen's method and by the process of drying milk previously coagulated with alcohol.

	HYDROGEN. Per cent.	HEIDLEN'S. Per cent.	ALCOHOL. Per cent.
First milk	9.20 — 9.20	9.25 — 9.24	9.25 — 9.23
Last milk	13.64 — 13.66	13.71 — 13.74	13.79 — 13.73

The results by Heidlen's and the alcohol methods are almost identical.

3. Comparative results obtained by Heidlen's method and by the process of drying milk previously coagulated with acetic acid.

	HYDROGEN. Per cent.	HEIDLEN'S. Per cent.	ACETIC ACID. Per cent.
First milk	9.04 — 9.03	9.11 — 9.09	9.12 — 9.12
Last milk	12.96 — 13.00	13.05 — 13.07	13.01 — 12.98

The results are again practically identical.

4. Comparative results obtained by Heidlen's method and by the "sand in excess" process.

	HEIDLEN'S. Per cent.	SAND IN EXCESS. Per cent.
First milk	9.25 — 9.24	9.25 — 9.23
Last milk	13.71 — 13.74	13.77 — 13.76
First milk	9.11 — 9.09	9.10 — 9.07
Last milk	13.05 — 13.07	13.04 — 13.07

The results are also practically identical.

Of the five methods of analysis tested, this Station prefers the "sand in excess" process, as with inexpensive apparatus a large number of determinations can be made in a short time without involving any labor except that of mixing the samples and weighing the quantities of milk and sand used.

Its results are found to be practically identical with those obtained by the *alcohol*, the *acetic acid* and *Heidlen's processes;* and approximately one-tenth of one per cent. *higher* than those secured by the standard, Hydrogen method.

II.

COB MEAL.

Inquiries have been made at the Station in regard to "Cob Meal" and its feeding value. As we have made no experiments in feeding it, we print the best we can find on the subject, for the information of inquirers. We shall be glad to learn more of the subject from those who have made carefully conducted experiments.

(*From The Connecticut Farmer, Nov. 15, 1879.*)

Report of the Joint Committee of the Pomfret and Woodstock Farmers' Clubs.

THE FEEDING VALUE OF CORN IN THE EAR, COMPARED WITH ITS VALUE WHEN GROUND WITH AND WITHOUT THE COB.

To the Secretaries of the Pomfret and Woodstock Farmers' Clubs:

GENTLEMEN:—At a meeting of the Pomfret Club the question of the feeding value of corn and corn cobs was discussed, and as many opinions advanced as there were persons present. A great diversity of opinion was also expressed in regard to the economy of feeding ground corn to hogs. A committee was therefore appointed, consisting of Messrs. Horace Sabin, Charles W. Grosvenor and Stephen O. Bowen, to confer with the Woodstock Farmers' Club, and, if found feasible, to test the question as thoroughly as possible. This committee found the Woodstock Club favorable to the idea, as the same variety of opinion and doubts had often been expressed at meetings of the club. They appointed a committee, consisting of Messrs. Charles Harris May, William B. Lester and Silas Newton. The joint committee, after due conference, purchased nine thrifty shoats, and divided them into three lots, as nearly uniform as possible, and commenced feeding them in the following manner: Lot No. 1 was fed upon clear meal and water; lot No. 2 upon cob meal and water; lot No. 3 upon corn and water only. They were kept in clean, tight pens for sixty-five days, viz; from March 31st to June 6th, and were fed all that they would eat of the best Northern corn, and an accurate account kept of the various weights fed. The amounts given are what was actually fed, without any regard to shrinkage, toll or expense of grinding. The corn weighed 59 pounds per bushel, which is the general average of Windom county corn. This experiment was conducted by Mr. Charles W. Grosvenor, under the direction of the committee.

We give you the facts and figures of the experiment as we find them, and hope it will induce further and fuller investigation. We would say that it was not the object of your committee to test the profit of pork making, but merely the relative value of corn in the three different modes of feeding; still, we think that we can make a good showing as to the profit of feeding pork.

In order that the eye may the more readily follow our figures, we present them in tabular form:

	Live Weight at Commencement.	Live Weight at Slaughtering.	Gain in Live Weight.	Gain per Bushel in Live Weight.
Lot No. 1	453	760	307	$13\frac{797}{1332}$
Lot No. 2	467	761	294	$15\frac{166}{1361}$
Lot No. 3	556	689	233	$11\frac{635}{1192}$

	Dressed Weight.	Net Gain of Pork.	Shrinkage.	No. Pounds Fed.
Lot No. 1	615½	249	19	1332
Lot No. 2	593	230	22	1361
Lot No. 3	582	196	16	1192

	No. Bushels Fed, (59 lbs. of Corn and Meal and 70 lbs. of Cob Meal.)	No. of Pounds Pork per Bushel.	Am't received from a Bushel of Meal and Corn at 6 cts. for Pork.	Per cent. of Pork.
Lot No. 1	22 34/59	11 13/444	66 78/444	18 231/334
Lot No. 2	19 41/70	11 1129/1361	70 1330/1361	19 138/144
Lot No. 3	20 14/59	9 259/298	59 64/298	16 187/298

So much for the general statement. It is interesting, however, to go farther into the details, as many may wish to know the particular facts in regard to each individual in the various lots and the method of our reasoning.

Pen No. 1—Hog No. 1 weighed 130 pounds; No. 2, 143 pounds; No. 3, 130 pounds. At slaughtering, live weight: No. 1 weighed 194 pounds, gain 64 pounds; No. 2, 263 pounds, gain 120 pounds; No. 3, 303 pounds, gain 123 pounds. Dressed weight: No. 1, 150 pounds; shrank in dressing 44 pounds; No. 2, 217 pounds; shrank 46 pounds; No. 3, 248 pounds; shrank 53 pounds.

This pen had eaten 1,332 pounds of clear corn meal, and we find that it took 4⅓ pounds of meal to make one pound of live hog. On the 5th day of June we find the live weight to be 760 pounds, and the market weight to be 615 pounds. Now, if it took 760 pounds of live weight to make 615 pounds of dressed pork, what would 453 pounds have made on the 31st day of March? And we find that it would have made 366 pounds, which taken from 615 pounds leaves 249 pounds, the gain of dressed pork, and we find that it took 5⅓ pounds to make one pound of dressed pork.

The individual weights of the second pen which were fed on corn ground on the ear, or as the common saying is, on cob meal, were as follows: No. 1, 122 pounds; No. 2, 174 pounds; No. 3, 171 pounds. On the 5th day of June they weighed; No. 1, 205 pounds, gain 83 pounds; No. 2, 277 pounds, gain 103 pounds; No. 3, 279 pounds, gain 108 pounds. This pen was slaughtered on June 6th, and weighed as follows: No. 1, 145 pounds, shrinkage 60 pounds; No. 2, 221 pounds, shrinkage 56 pounds; No. 3, 227 pounds, shrinkage 52 pounds. By taking the figures of the above table, and following the method of reasoning given, it shows that it took $4\frac{185}{294}$ pounds of meal to make one pound of live hog, and that it took a fraction less than 6 pounds to make one pound of dressed meat. Reducing this to clear grain: By allowing 70 pounds of ears to make 59 pounds of shelled corn, and as they had eaten 1,146 pounds of clear meal, we find that it took $3\frac{1}{8}$ pounds to make one pound of live hog, and that it took 5 pounds of the same to make one pound of merchantable pork.

Both of these pens had been fed on the meal mixed with cold water at the time of feeding.

The third pen was weighed on the same days, and weighed as follows: Hog No. 1, 180 pounds; No. 2, 138 pounds; No. 3, 138 pounds; the whole weight, 456 pounds. On the 5th day of June they weighed as follows: No. 1, 250 pounds, gain, 70 pounds; No. 2, 226 pounds, gain, 88 pounds; No. 3, 213 pounds, gain, 75 pounds; whole gain, 233 pounds. The market weight of them was: No. 1, 212 pounds, loss in dressing, 38 pounds: No. 2, 194 pounds, loss, 32 pounds; No. 3, 175 pounds, loss, 38 pounds; whole shrinkage in dressing, 108 pounds. This pen had been fed on corn thrown to them on the ear, and water for drink. They had eaten 1,415 pounds of ears of corn, and we find that it took $6\frac{3}{46}$ pounds of ears of corn to make one pound of live pork, and by the rule adopted, we find that the hogs would have dressed on the 31st day of March 385 pounds, which showed a gain of 197 pounds of meat, and that it took $7\frac{1}{20}$ pounds of ears of corn to make one pound of meat. Reduce this 1,415 to clear corn, and it shows that they had eaten 1,192 pounds, which shows that it took $5\frac{8}{79}$ pounds of corn to make a pound of live pork, and that it took $6\frac{10}{197}$ pounds to make a pound of dressed meat.

To recapitulate: We find that it took $4\frac{1}{3}$ pounds of meal in the first pen to make one pound of live weight, and $5\frac{1}{3}$ pounds to make one pound of dressed weight.

In the second pen it took $4\frac{185}{294}$ pounds to make one pound of live weight, and a fraction less than 6 pounds to make a pound of dressed meat. Reducing this to clear meal, we find that $3\frac{1}{8}$

pounds made a pound of live meat, and five pounds made a pound of dressed meat.

The third pen took $5\frac{8}{79}$ pounds of clear corn to make one pound of live weight, and $6\frac{10}{197}$ pounds to make a pound of dressed meat.

III.

FORMULAS FOR MIXING FERTILIZERS.

A constant demand for formulas is made upon this Station by farmers who intend to mix fertilizers for their own use.

By so doing they expect to obtain their plant food at low prices, and at the same time furnish employment during a portion of the winter for their own hired laborers.

The Station does not claim to be able to tell farmers which mixture will be most profitable for their use. It aims solely to show how mixtures can be made which will correspond with those offered for sale by the manufacturers in this State.

To do this it has tabulated all the available guaranteed analyses of complete manures, and arranged them in five classes; the percentage of nitrogen forming the basis of the classification.

CLASS I.

All fertilizers in which the guaranteed nitrogen does not exceed one per cent.

This is a small class containing three brands.

CLASS II.

All fertilizers in which the guaranteed nitrogen ranges from one to two per cent.

This is a large class containing twenty-four brands, of which sixteen are intended for general use, and eight are so called specials, for fruit, tobacco, potatoes, lawn dressing, hops and buckwheat.

CLASS III.

All fertilizers in which the guaranteed nitrogen ranges from two to three per cent.

This class includes eighteen brands, of which eleven are for general use and seven are so-called specials, for potatoes, sorghum, etc.

CLASS IV.

All fertilizers in which the guaranteed nitrogen ranges from three to four per cent.

This class includes twenty-one brands, of which five are for general use, and sixteen are so-called specials, for grain, tobacco, potatoes and vegetables in general.

CLASS V.

All fertilizers in which the guaranteed nitrogen exceeds four per cent.

This contains six brands only, of which five are specials, for tobacco, lawn dressing, grain and vegetables.

In calculating the proportions of crude materials to use in making up a ton of fertilizer, on either of these formulas, it was assumed that

Sulphate of Ammonia	contains	20	per cent.	of	nitrogen.
Nitrate of Soda	"	16	"	"	"
Blood and Ammonite	"	12	"	"	"
Bone Black Superphosphate	contains	16	"	"	available phos. acid.
Acid Phosphate from S. C. Rock,	contains	12	"	"	" " "
Muriate of Potash	"	50	"	"	potash.
Kainite	"	12	"	"	"

No difficulty will be experienced in securing supplies guaranteed to contain the above percentages of plant food.

The value of the plant food in an unmixed condition given with each formula, was calculated by using the manufacturers' averaged retail prices for 1884; these can be found in detail in this Report, under the discussion of Commercial Relations of Fertilizers.

Occasionally, requests are received for material to be used in feeding ornamental plants and flowers.

Special preparations for this purpose can be found upon the market.

When they cannot be obtained, a mixture of one pound of nitrate of potash and two pounds of phosphate of soda, can be easily bought in many towns from druggists.

One or two teaspoonfuls of this mixture, dissolved in about one gallon of water, may be used with good effect in moistening the soil around flowering or foliage plants.

CLASS I.

To make One Ton mixed together.		Containing Pounds of		Equivalent to
Blood	110 lbs.	Nitrogen	13.2	.66 per cent.
S. C. Rock	1600 "	Phosphoric Acid	192.0	9.60 "
Kainite	250 "	Potash	30.0	1.50 "
Total	1960 lbs.			

Cost of material unmixed . . . . $19.36.

CLASS II.

To make One Ton mixed together.		Containing Pounds of		Equivalent to
Nitrate of Soda	100 lbs.	Nitrogen	32.8	1.64 per cent.
Ammonite	140 "			
S. C. Rock	1400 "	Phosphoric Acid	168.0	8.40 "
Muriate of Potash	50 "	Potash	61.0	3.05 "
Kainite	300 "			
Total	1990 lbs.			

Cost of material unmixed $21.40

CLASS III.

To make One Ton mixed together.		Containing Pounds of		Equivalent to
Sulphate of Ammonia	50 lbs.	Nitrogen	47.0	2.35 per cent.
Nitrate of Soda	100 "			
High Grade Blood	175 "			
South Carolina Rock	1450 "	Phosphoric Acid	174.0	8.70 "
Muriate of Potash	125 "	Potash	74.5	3.78 "
Kainite	100 "			
Total	2000 lbs.			

Cost of material unmixed . . . . $25.31.

CLASS IV.

To make One Ton mixed together.		Containing Pounds of		Equivalent to
Sulphate of Ammonia	100 lbs.	Nitrogen	72.0	3.60 per cent.
Nitrate of Soda	100 "			
High Grade Blood	300 "			
Bone Black Superphos.	940 "	Phosphoric Acid	150.0	7.50 "
Muria[illegible] of Potash	100 "	Potash	110.0	5.50 "
Kainite	500 "			

Total . . . . . . 2040 lbs.

Cost of material unmixed . . . . $27.46.

CLASS V.

To make One Ton mixed together.		Containing Pounds of		Equivalent to
Sulphate of Ammonia	150 lbs.	Nitrogen	104.0	5.20 per cent.
Nitrate of Soda	200 "			
High Grade Blood	350 "			
Bone Black Superphos.	875 "	Phosphoric Acid	140.0	7.00 "
Muriate of Potash	75 "	Potash	80.0	4.00 "
Kainite	350 "			

Total . . . . . . 2000 lbs.

Cost of material unmixed . . . . . . $31.06.

APPENDIX.

ACT OF INCORPORATION.

The New Jersey Agricultural Experiment Station was established by authority of the following acts of the Legislature of the State :

CHAPTER CVI.

AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF AN AGRICULTURAL EXPERIMENT STATION.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey,* That for the benefit of practical and scientific agriculture, and for the development of our unimproved lands, the New Jersey Agricultural Experiment Station, with suitable branches, is hereby established.

2. *And be it enacted,* That the direction and management of this institution shall be committed to a Board of Directors, which shall consist of the Governor of the State, the Board of Visitors of the State Agricultural College, together with the President and the Professor of Agriculture of that institution.

3. *And be it enacted,* That the members of this Board shall be called together by the Secretary of the Board of Visitors, and shall organize by the election of a president and secretary, who shall hold their offices for one year, and until their successors are elected; five members shall constitute a quorum.

4. *And be it enacted,* That the Board of Directors shall hold a meeting each year, at Trenton, on the third Tuesday in January, and other meetings at the call of the President, at such times and places as may best promote the objects of the institution.

5. *And be it enacted,* That the Board of Directors shall locate said Experiment Station and branches, and shall appoint a Director, who shall have the general management and oversight of the experiments and investigations necessary to carry out the objects of said institution, and shall employ competent chemists, and other assistants necessary to analyze soils, fertilizers and objects of agricultural interest, so as to properly carry on the work of the Station, and it shall make an annual report of its work to the Governor of the State.

6. *And be it enacted,* That a sum not exceeding five thousand dollars in any one year, is hereby appropriated to said New Jersey Experiment Station, which money shall be paid out from the State Treasury on the presentation of the bills of said Station, properly certified by the President and Secretary of the Board of Directors.

7. *And be it enacted,* That this act shall take effect immediately.

Approved March 10th, 1880.

CHAPTER LXXXI.

A SUPPLEMENT TO THE ACT ENTITLED "AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF AN AGRICULTURAL EXPERIMENT STATION," APPROVED MARCH TENTH, ONE THOUSAND EIGHT HUNDRED AND EIGHTY.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey,* That from and after the passage of this act, the Board of Directors, mentioned and created by said act, shall be called and known as the Board of Managers.

2. *And be it enacted,* That in addition to the powers now conferred upon said Board, they shall have power to elect a Treasurer, who shall hold his office for one year, and until his successor shall be elected and qualified; and to appoint such other officers and agents as may be necessary to carry on the business of the institution; and to make such rules, by-laws and regulations for the government of the Board, and for carrying out the objects, business and purposes of the institution, as may, in their judgment, be necessary and proper.

3. *And be it enacted,* That the annual appropriation for the support of the New Jersey Agricultural Experiment Station be

and the same is hereby increased from its present sum of five thousand dollars a year to eight thousand dollars a year.

4. *And be it enacted,* That this act shall take effect immediately.

Approved March 9th, 1881.

CHAPTER CCVIII.

A SUPPLEMENT TO THE SUPPLEMENT TO AN ACT ENTITLED "AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF AN AGRICULTURAL EXPERIMENT STATION," APPROVED MARCH NINTH, ONE THOUSAND EIGHT HUNDRED AND EIGHTY-ONE.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey,* That section three of the supplement to the act entitled "An act to provide for the establishment of an Agricultural Experiment Station," be amended so as to read as follows:

[3. *And be it enacted,* That the expenses of said station, when presented to the comptroller of the State, accompanied by the proper vouchers, duly certified by the President and Secretary of the Board of Directors, shall, upon warrant of said comptroller, be paid out of the State Treasury; provided, such expenses do not exceed the sum of eleven thousand dollars in any year.]

2. *And be it enacted,* That this act shall take effect immediately.

Approved May 9, 1884.

LAWS OF NEW JERSEY.

AN ACT TO REGULATE THE MANUFACTURE AND SALE OF FERTILIZERS.

1. That every commercial fertilizer which shall be offered for sale in this State shall be accompanied by an analysis, stating the percentage therein of ammonia, or its equivalent of nitrogen; of potash, in any form or combination, soluble in distilled water; and of phosphoric acid in any form or combination; the portion of phosphoric acid soluble in distilled water; that portion soluble in a neutral solution of citrate of ammonia at a temperature not exceeding one hundred degrees Fahrenheit; and that portion of phosphoric acid not soluble in either of the above named fluids, shall each be determined separately; and the material from which the phosphoric acid is obtained shall also be stated; a legible statement of such analysis shall accompany all packages or lots of over one hundred pounds, sold, offered or exposed for sale.

2. That the Chemist of the State Board of Agriculture shall be the Inspector of Fertilizers; it shall be his duty to analyze one or more samples of every kind of commercial fertilizers coming within the provisions of this act, which may be offered for sale within the State, and of which he shall be informed.

3. That manufacturers, dealers, and all persons interested, may obtain an analysis by notifying the Chemist of the State Board of Agriculture, upon which notification he shall be authorized to analyze at his discretion, samples selected by himself, and to furnish certified copies of such analysis to the persons on whose application they were made; and it shall also be his duty to report all such analyses to the State Board of Agriculture.

4. That the Chemist of the State Board of Agriculture shall receive for each certificate of analysis made by him, a sum not to exceed fifteen dollars, to be paid by the person or persons applying therefor.

5. That any person selling, offering or exposing for sale any commercial fertilizer without the analysis required by the first section of this act, or with an analysis stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense, and one hundred dollars for each subsequent offense.

Approved March 24th, 1874.

SUPPLEMENT.

Sec. 1. That the penalty or penalties prescribed in section five of that act may be sued for and recovered, in an action of debt, in any court of competent jurisdiction in this State, in the name of any person who will sue for the same, one-half thereof for his own use, and the other half to be paid to the county superintendent of public schools of the county in which such suit or suits shall be brought, for the use of the public schools in their county.

Approved March 31st, 1875.

A SUPPLEMENT TO AN ACT ENTITLED "AN ACT TO REGULATE THE MANUFACTURE AND SALE OF FERTILIZERS," APPROVED MARCH TWENTY-FOURTH, ONE THOUSAND EIGHT HUNDRED AND SEVENTY-FOUR.

1. Be it enacted *by the Senate and General Assembly of the State of New Jersey,* That the fifth section of the act to which this act is a supplement, which section now reads as follows:

"5. *And be it enacted,* That any person selling, offering or exposing for sale any commercial fertilizer without an analysis required by the first section of this act, or with an analysis stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense," be and the same is hereby amended so as to read as follows:

5. *And be it enacted,* That any person selling, offering or exposing for sale any commercial fertilizer without any analysis required by the first section of this act, or the act to which this act is a supplement, or with an analysis stating that the said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense; *provided further,* that the provisions of this section, or the act to which this act is a supplement, shall not apply to any manure sold at a price not exceeding one-half a cent per pound, nor to any imported guanos.

2. *And be it enacted,* That this act shall take effect immediately.

Approved March 27th, 1878.

INSTRUCTIONS

For Taking Samples of Commercial Fertilizers for Analysis.

The sampling must be done with care so as to do no injustice either to the buyer or seller. Samples should only be taken from bags, barrels or packages, which are in good condition, and have not been wet or exposed to the weather so as to become either damper or drier than they probably were when sent from the manufacturer. It is not desirable to sample lots of less than a half ton. In small lots a portion may be taken from each bag or barrel; in larger lots a portion may be taken from every fifth or tenth bag. In case the fertilizer is caked it can easily be crumbled fine again by tumbling the bags over thoroughly.

The sample is to be taken by the sampling tube, inserting it in the corner of the bag, or the head of the barrel, and pushing it through the centre of the fertilizer for its whole length.

The sampling tube which is a copper tube 1¼ in. diameter and nearly 3 feet long, is so made that it can be entered empty into the fertilizer, and when in its place a slot can be opened for its whole length, and the fertilizer will fall into it; then it can be closed and drawn out and emptied. The quantity drawn out will be a fair average of all that is in the package. If samples are taken from several packages of the same brand they must be put together on a clean paper and carefully mixed, and the sample for analysis taken from this.

The sample drawn for analysis, which may be a quart, should be immediately put into a glass fruit jar and tightly closed so as not to lose or gain any weight from moisture. Mark the jar with proper label.

Note accurately on the accompanying Form for Description the brand of the fertilizer, the manufacturers' name and place of business, the name and location of the dealer, the analysis guaranteed and the price at which the fertilizer is sold; with any remarks on the condition of the stock and the way it is kept. Sign this and send it with the sample to the Station. The jars should be wrapped with paper and packed in baskets, boxes or crates, so as to insure safe carriage; marked "N. J. Agricultural Experiment Station, New Brunswick, N. J.," and sent by express.

FORM FOR DESCRIPTION OF SAMPLE FOR ANALYSIS.

The person sending samples to the Station for Analysis without charge, will be provided with a Form like this for each sample, and must fill up every one of the blank particulars given, so as to make the description complete and definite, *and in every case write his signature, as endorsing the accuracy of it.* As there is much responsibility in taking fair average samples, such as will justly represent the manufacturer as well as the consumer, it is very important that every precaution be taken, so that in case of a suit at law the person signing the description can testify to its accuracy. The writing should be plain and legible. The filled-out form, if wrapped with the sample, will serve as a label. If any printed circular, pamphlet, analysis or statement accompanies the fertilizer, or is used in its sale, send a copy with the specimen.

1. *Brand of Fertilizer* . . . .
2. *Name and address of Manufacturer* . . . .

. . . .

3. *Name and address of Dealer from whose stock this sample is taken,*

. . . .

4. *Date of taking this sample* . . . .
5. *Selling price per ton, hundred, bag or barrel* . . . .
6. *Selling weight claimed for each package weighed* . . . .
7. *Actual weights of packages opened* . . . .
8. *Copy of analysis or guaranteed composition affixed to packages of this Fertilizer* . . . .

. . . .

. . . .

. . . .

9. *Signature of person taking sample* . . . .

Name . . . .

P. O. Address . . . .

ORDER OF STATION WORK.

The largest portion of the Station work is in the Analysis of Fertilizers, Field Experiments, Feeding Experiments, with Analyses of Foods, Fodders, Milk, &c. To do these branches of work well, continuous and steady attention must be given to each of them while it is in progress, and other business has to be laid aside for the time. To make this necessary order of work as little disappointing as possible for those who desire work at the Station, we publish this statement of the subjects upon which we propose to work at the different periods of the year:

Feeding Experiments.	January and February.
Analyses of Fertilizers.	March to September 15th.
Field Experiments.	April and May.
Field Experiments.	Sept. 15th to Nov. 30th.
Annual Report.	December.

Miscellaneous work of various kinds may arise to interfere with the perfect regularity of this plan, but for accomplishing the largest amount of work it will be necessary to adhere as closely to it as possible.

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* * *

SIXTH ANNUAL REPORT

OF THE

NEW JERSEY STATE

AGRICULTURAL EXPERIMENT STATION

FOR THE YEAR

1885.

◆

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JOHN L. MURPHY, STATE PRINTER.
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GEO. H. COOK,
Director N. J. Agricultural Experiment Station,
NEW BRUNSWICK, N. J.

Please acknowledge receipt.

To His Excellency Leon Abbett, Governor of the State of New Jersey:

SIR—I have the honor to submit herewith the sixth annual report of the New Jersey State Agricultural Experiment Station, as required by the law establishing the Station, which was approved March 10th, 1880, and which is chapter CVI. of the laws of that year.

WILLIAM S. TAYLOR,
President.

NEW BRUNSWICK, N. J., December 30th, 1885.

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TREASURER'S REPORT.

◆

James Neilson, in account with the New Jersey State Agricultural Experiment Station, January 1st, 1885, to January 1st, 1886:

RECEIPTS.

From State Treasurer	$12,229 82

PAYMENTS.

Salaries and pay of chemists and assistants	$7,200 47
Expenses of the Board of Managers	108 02
Stationery	192 16
Printing	354 69
Postage	546 90
Telephone service	120 00
Fuel	53 75
Gas	44 00
Laboratory expenses	1,164 56
Field and feeding experiments	1,093 17
Freight and express bills	52 95
Expenses collecting samples of fertilizers	191 36
Traveling expenses	141 14
Periodicals	5 27
Rent	583 33
Type-writer	107 50
Office and laboratory safes (2)	185 00
Miscellaneous and incidental expenses	85 55
	$12,229 82

Respectfully submitted,

JAMES NEILSON,
Treasurer.

The Auditing Committee of the Experiment Station have examined the accounts of the Treasurer of said Station and find them correct.

ABM. W. DURYEE,
I. M. SMALLEY.

SIXTH ANNUAL REPORT.

The work of the Experiment Station during the year 1885 has been in the same lines of investigation as in former years. The analysis of fertilizers is demanded to meet the wants of the farmers and to aid in the development of an important and growing branch of manufacture. There have been analyzed in the Station Laboratory during the year—

117 samples of complete fertilizers.
30 samples of incomplete fertilizers.
82 samples of stock for compounding fertilizers.

The results of these analyses show that the Station's work is salutary. There are very few samples in which the fertilizing constituents fail to be up to the guarantees which are claimed for them by manufacturers. The list of brands analyzed, with the manufacturers' names, the guaranteed composition and the analyses, are published in full in this report.

The market prices of the various brands are also given in comparison with their commercial values as computed at the Station by the use of uniform prices which were published at the beginning of the year. The Station prices are carefully determined from the wholesale prices ruling in the great markets of the country, and allowing a reasonable percentage of profit. These prices are naturally the subject of criticism from parties interested, both among the manufacturers and the farmers. But we give in detail the market quotations, from which the Station prices are made up, and we believe they are such as meet the approval of fair-minded business men. Attention is called to the lists of market quotations and the prices deduced from them as they are given under their appropriate headings farther on in this report.

As the demand for commercial fertilizers increases there is a corresponding effort to furnish the requisite supply. New materials for stock are being introduced, the general effect of which is to lower the prices of the mixed fertilizers, but it throws upon the chemical laboratories much additional work, and in some cases introduces materials of unsettled and questionable value. It may substitute a new kind of stock which has an ascertained and known composition and commercial value, but which may not have the agricultural value of some long-used substance containing the same chemical element of fertility. This has been the case most frequently in regard to phosphoric acid. The phosphoric acid in bones was that first used in fertilizers, and it is still the form which is unexceptional to all. The needs of agriculture are, however, too great to be supplied from this source alone, and phosphates of lime, from South Carolina rock, from apatite (crystallized phosphate of lime), and from various kinds of phosphatic guanos, have been substituted for the real bone phosphate; and still later phosphates of iron and of alumina have been brought into market and are now for sale. Where the phosphates have been made soluble by the addition of sulphuric acid there is probably no difference in their action or agricultural value. Those made from the mineral phosphates, however, are more liable to revert, that is, to go back into an insoluble state—a form of phosphate which is not considered to be quite as useful as that which is in a soluble form. It is known to have much agricultural value. Fine ground bones without treatment with sulphuric acid have been used for a fertilizer with profit for many years. The use of finely ground mineral phosphates of all kinds has been advocated by many intelligent farmers, and experiments have shown that they have some agricultural value in this form. Experiments as to their effects on growing crops have been made at the Station the past summer and some are still in progress. Positive conclusions cannot be looked for in a single season's experiments. The details of the experiments are given in the body of this report.

The existence of increased quantities of reverted and insoluble acid in fertilizers has led chemists to review their methods of analyzing such phosphates, and in several of the States, as well as among manufacturers, it has been thought proper to use the temperature of 150° Fahr. instead of 100° Fahr. in determining the solubility of reverted phosphoric acid. At the former temperature the solubility is greatly increased over that of the latter. In some phosphates the increase of solubility is much greater than it is in others. Our own State law requires the reverted phosphoric acid to be estimated by the temperature of 100° Fahr., and with the variable results obtained we have not felt warranted in asking the Legislature to alter the law in that respect. We have, however, determined the percentage of phosphate which was soluble at each of the temperatures mentioned in most cases. In this way the question is brought fully to the attention of thoughtful men, and when definite conclusions are reached we shall be prepared to recommend the method which will most fairly represent the value of these phosphates.

The manures containing potash are coming into very general use, and the prices at which they are sold are much below those of former times when all the supplies were obtained from wood ashes. In the field experiments with sulphate of potash and muriate of potash the results do not show any special benefit for one over the other to the growing crops, though the former has heretofore cost at least fifty per cent. more than the latter.

The nitrogen in commercial fertilizers is their most expensive constituent. It should be the aim of farmers to economize in this as much as possible. It is contained in barn-yard manure in considerable quantity. Average barn-yard manure contains about a half per cent. of nitrogen; this is equivalent to ten pounds per ton, which is as much as there is in sixty-two pounds of nitrate of soda or in fifty pounds of sulphate of ammonia, and at this rate five tons of barn-yard manure will contain as much nitrogen as 310 pounds of nitrate of soda or 250 pounds of sulphate of ammonia, which are quantities twice as great as farmers usually apply on an acre of ground for the best of crops. A well-managed farm will annually produce from 250 to 350 tons of farm-yard manure per hundred acres, and by judicious care in feeding it may produce much more. By a proper addition of superphosphate of lime and potash salts with this manure it can be made, at a very moderate expense, to supply all the fertilizing material needed to keep the whole farm in the most profitable and productive state. The analyses of stock for fertilizers will show how this can be most economically done.

The feeding of animals on the farm for the production of manure is closely connected with this subject, and a large number of feeding stuffs such as are in the market have been analyzed to ascertain their value for feed and also for manure. Their contents of potash, phosphoric acid and nitrogen are put down separately. In cases where protein only is put down the nitrogen can be determined by dividing the former by 6.25, and then, as the potash and phosphoric acid are all excreted by the animal, they may be estimated as part of the manure produced. The nitrogen is always somewhat diminished in its passage through the body of the animal—in extreme cases nearly one-third—so that in making an estimate it is prudent to estimate it as only two-thirds of that in the original feeding and fodder stuffs. From these figures the manurial value of the foods can be estimated, as well as the benefits to be derived by a farmer from buying feed, and consuming it in the production of manure, as well as of meat and milk.

The computation of rations in which waste feeding stuffs containing an excess of nitrogen are to be mixed with cut straw, cornstalks or other coarse fodders which are deficient in nitrogen is a most important part of farm economy. The examples which are given in the tables upon this subject, with the composition of incomplete foods, furnish a basis from which farmers may compute other rations.

The field experiments which are given in detail in the report have two objects in view, one to determine the kinds of fertilizers which have the most profitable effect upon different crops, and the other to determine the deficiencies of the soils in various parts of the State. The variations in the seasons, the checks from droughts and the injuries from excess of rain affect the crops to such an extent that no reliable conclusions can be drawn from the results of a single year's experiments. It is necessary to take the average results from a number of years' experiments, and from those to form a judicious and safe course of farm practice.

The manufacture of sugar from sorghum cane has now been on trial in Cape May county for five years. A large capital has been invested in land, buildings and machinery for carrying on the manufacture on a large scale. The company which is located at Rio Grande in that county has 3,000 acres of land, and including buildings, mills and machinery, an investment which is estimated at $250,000. They are prepared to work 10,000 tons of cane a year. They have encountered many difficulties in beginning a new industry, and with the extremely low price of sugar they have probably not made any profit on their investment. The importance of this enterprise is felt throughout the whole county in which it is located, and to some extent in all southern New Jersey. The price of land has been raised, and the value set upon it by farmers has increased in a very marked manner.

The importance of establishing a new branch of industry in our State, and of introducing a crop so well suited to the soils of the southern counties, have led the Station to give special attention to this subject. During the past season Dr. Neale, the chemist of the Station, has spent some weeks at the sugar house and much other time in studying the details of the manufacture and the difficulties to be met in bringing the works to economical and profitable working. The sugar produced is of good quality, and the syrup made finds a ready market. The amount produced from an acre of ground by the ordinary process of milling has, however, not been satisfactory. The average crop of cane on the whole plantation has been only about seven tons per acre, and from a ton of cane about forty pounds of sugar and seven gallons of syrup have been obtained. The experiments of the season which were carried out on a manufacturing scale for a few days have demonstrated that by using the method of diffusion, that is, of taking the sugar from the cane by means of water, the product is doubled. No difficulty was experienced in working by this method and getting out the sugar.

The leaves of the sorghum, when it is worked by the diffusion process, impart some peculiar color and taste to the sugar and syrup, and to avoid this the cane has to be stripped before it is cut up and put in the diffusers. For economy, the work of stripping the cane must be done by machinery, and men thoroughly conversant with the work which is required to be done are now engaged in constructing such a machine. There is a favorable prospect for the permanent location of this industry in our State, and the examinations made in the laboratory and on our experiment plots prove that the cane which can be grown on an acre, with ordinary fertilization and tillage, will yield from a ton to a ton and a half of sugar and twenty bushels of seed.

For the supply of our own citizens we need yearly 31,250 tons of sugar, and as many acres of sorghum in cultivation to produce it. We have in the State more than a million acres of land which is well adapted to this crop, most of which is not now in cultivation.

To those who are interested in the industrial prosperity of the State this is a very promising subject of investigation, and the details of work done in it, as given farther on in the report, will be looked at with satisfaction.

The reports of Mr. J. M. White upon peaches and peach trees, of Mr. E. Williams upon grapes and grape growing, and of Mr. A. P. Arnold upon sweet potato cultivation, are referred to with much pleasure. These gentlemen are experienced in the subjects upon which they write, and it is of much interest to make record of their statements of the present condition of these branches of fruit and farm culture. New Jersey has long been noted for the superior quality of its fruits. In later years it has lost something of this good reputation, due, perhaps, to the prevalence of some plant diseases, or partly to exhaustion of the soil. The successful use of chemical and other fertilizers has much improved the quantity and quality of the fruit grown, and has encouraged the fruit growers to greater efforts, and the impression is growing with them that perhaps the diminished crops have been due to thin or exhausted soils, more than to any diseases of the plants. This questionable point is now in a fair way to be correctly settled.

It is proper to acknowledge the service which has been rendered to the Station and to the farmers of the State by Messrs. Baker, Nicholson, Budd, Grover, and White, in collecting the samples of fertilizers for analysis. The integrity and fairness of our samples is an essential part of the Station's strength, and it is a material aid to have those men who have the confidence of our farmers, and have no desire for employment of this kind, except for the public good, assist the Station in this way. Samples may be taken from bags which are or have been wet, or from those which have been dried too much. They may be taken from the edge of a pile down which only the coarser lumps have rolled out, or from the finer part which has sifted out from the rest. In all such cases, and many others, very unfair samples may be taken, and we are continually receiving at the Station little samples taken in such ways, which we are obliged to decline, as it would be unfair and perhaps damaging to innocent parties to have them analyzed and published. We esteem the Station fortunate in securing the assistance of such help, and we trust that all will appreciate the pains taken to get reliable material for the bulletins and report.

The Station has also been favored by the assistance of Messrs. James Neilson, of New Brunswick; Taylor Bros. and L. T. Derousse, of Camden; J. J. Mitchell, of Whippany; Omar Borton, of Woodstown; William S. Vanderhuff, of Deckertown; H. I. Budd, of Mt. Holly and R. K. Buckman, of New York, in collecting samples of the feeding stuffs for sale in the markets and consumed in the feeding of stock in different parts of the State. Great pains were taken to get representative and fair specimens of the kinds in common use, as some instances have been reported of their adulteration with innutritious and worthless material. The thanks of the Station are due to these gentlemen for their assistance and the valuable matter they have enabled us to add to the report.

An important part of the work of the Station is to furnish early information directly to the farmers of the State upon subjects of immediate interest to them, and in that way to increase the profits of agriculture and to lighten its labor.

There have been issued during the year:

Bulletin XXXV. Schedule of prices and analyses of crude stock.
Bulletin XXXVI. Analyses and valuations of complete fertilizers.
Bulletin XXXVII. Miscellaneous fertilizers.
Bulletin XXXVIII. The Rio Grande Sorghum Sugar Works.

Over 5,000 copies of each of these have been printed and sent by mail directly to farmers, and the Station responds to all new applications which are made for copies of the bulletins.

FERTILIZERS.

STATISTICS OF FERTILIZERS CONSUMED IN NEW JERSEY DURING THE YEAR ENDING NOVEMBER 1ST, 1885.

These statistics were taken by manufacturers from their books in answer to requests made by this Station. The reports were in each case returned on printed forms, of which the following is a copy :

SALES OF COMMERCIAL FERTILIZERS.

The following is a correct statement of the number of tons of the several classes of Commercial Fertilizers sold in New Jersey by ———— ———— during the year ending November 1st, 1885:

Number of tons of Complete Manure ....
" " Ammoniated Superphosphate without Potash (Dissolved Bone, etc.)..
" " Ground Bone..
" " Kainite ....
" " Muriate of Potash..
" " Nitrogenous Matter..
(*a*) Ammonium Sulphate..
(*b*) Sodium Nitrate..
(*c*) Blood, Ammonite, etc..
Number of tons of Plain Superphosphates, including both Dissolved Bone Black and S. C. Acid Phosphate............

One firm, for business reasons, declined to make a report; four firms neglected to answer the Station's letters, thirty-five firms made returns of sales which aggregate *thirty-seven thousand eight hundred and ten tons,* divided as follows. For comparison, the returns for 1882 and 1884 are again republished :

	1882	1884	1885
Number of tons of Complete Manure	15,941	21,894	22,424
" " Ammoniated Superphosphate without Potash, Dissolved Bone, etc.	1,370	1,541	1,603
" " Ground Bone	2,509	3,172	2,237
" " Kainite	683	991	584
" " Muriate of Potash	144	291	331
" " Ammonite	719	783	250
" " Ammonium Sulphate	76	54	55
" " Sodium Nitrate	26	40	17
" " Blood	244	1,581	263
" " Fish	228	228	.....
" " Hair	248	574	434
" " Poudrette	3,450	10,200	6,000
" " Superphosphates, 30–40 per cent	562	.....	.....
" " Superphosphates, 11-18 per cent	3,963	5,315	.....
" " Bone Black Superphosphate	.....	.....	2,488
" " S. C. Rock	.....	.....	1,124
Total	30,163	46,664	37,810

The differences, amounting to nearly *nine thousand tons* between the records for 1884 and 1885, are in a measure due to the abovementioned fact, viz., that five of the firms included in last year's list have this season made no reports. Further, the returns for 1884 included approximately *two thousand tons* of plain superphosphates and nearly *one thousand tons* of dried blood, which in all probability had been *wholesaled* to *dealers*, mixed by them into complete manures, and in this form reported a second time to the Station. The record for 1884 is therefore too high, possibly by *three thousand tons.*

One return of *five hundred and thirty tons* was this season made in such a manner that it could not be classified; it was therefore excluded from the above table.

The sales for the year 1885 have in all probability equaled those of any previous year, the recorded differences being due solely to the Station's inability to secure complete statistics.

THE AVERAGE RETAIL PRICES FOR 1882, 1884 AND 1885.

	1882	1884	1885
Complete Manure	$41 00	$38 00	$35 73
Ammoniated Superphosphate without Potash (Dissolved Bone, etc.)	32 00	31 00	31 62
Ground Bone	37 00	36 00	31 25
Kainite	12 00	10 00	11 75
Muriate of Potash	41 00	38 00	42 15
Ammonite	56 00	43 00	43 00
Ammonium Sulphate	99 00	70 50	68 50
Sodium Nitrate	76 00	54 00	52 25
Blood	56 00	43 50	38 67
Fish	45 00	31 50	34 66
Hair	10 00	11 00	10 00
Poudrette	10 00	10 00	10 00
Superphosphates with 30 to 40 per cent. Phos. Acid	75 00	......	......
Superphosphates with 11 to 18 per cent. Phos. Acid	28 50	24 50	......
Superphosphates made from Bone Black	.....	......	29 86
" " " S. C. Rock	......	......	20 81

These prices represent the average retail cash cost per ton, at *factory depots*, of material in the different classes; the expenses for freight, and for cartage at *consumers' depots*, are not included in these averages.

In case of the complete manures, the price $35.73 per ton is an average drawn from the retail cash cost of *one hundred and five* different brands, sampled and analyzed by this Station and sold in this State during the past year. The same statement applies to all of the other averages in this table; the number of samples entering into each calculation being given upon subsequent pages.

Compared with the record for 1884, the average retail price for *complete fertilizers*, in 1885, declined by *six per cent.*; the average price for *ground bone* also declined by approximately *fourteen per cent.*

The average retail price, per ton, of *muriate of potash* and of *kainite* advanced in each case, the muriate by approximately *ten per cent.*, and the kainite by seventeen per cent. Upon the average, the retail prices of nitrogenous matters either remained unchanged or declined slightly, fish and blood forming the only exceptions.

The total value of the commercial fertilizers, reported as used in this State, can be easily calculated from the data in the two preceding tables.

Compared with the totals for 1882 and 1884, the results are as follows:

Total value of fertilizers reported for 1882	$1,070,113 00
" " " " " " 1884	1,369,004 00
" " " " " " 1885	1,116,670 00

THE COMMERCIAL AND AGRICULTURAL RELATIONS OF FERTILIZERS.

In using commercial fertilizers, there are three ways in which farmers may suffer heavy losses—

1. By paying higher prices than the open market demands.
2. By failing to receive the amount and kind of plant-food for which they have paid.
3. By failing to use the kind and quantity of plant-food needed by their soils and crops.

The first and second points deal exclusively with buying and selling. They are, therefore, properly considered under the heading of *commercial relations of fertilizers.*

The third point bears directly upon the uses made of manures. It excludes everything related to buying and selling, and should be discussed under the *agricultural relations of fertilizers.*

I.

THE COMMERCIAL RELATIONS OF FERTILIZERS.

The commercial relations of fertilizers include—

A. *Their Market Prices.*
B. *Their Guaranteed Chemical Composition and Relative Commercial Values.*

A.

THEIR MARKET PRICES.

The following points bear either directly or indirectly upon the average retail prices of fertilizers in this State:

1. The average *wholesale* prices of nitrogen, phosphoric acid and potash, in the crude stock out of which merchantable fertilizers are made.

2. The average *retail* prices of nitrogen, phosphoric acid and

potash, in the crude stock out of which merchantable fertilizers are made.

3. The comparison between the average *wholesale* and *retail* prices of nitrogen, phosphoric acid and potash in crude stock.

1.

THE WHOLESALE PRICES OF NITROGEN, PHOSPHORIC ACID AND POTASH IN THE CRUDE STOCK, FROM WHICH MERCHANTABLE FERTILIZERS ARE MADE.

The weekly reports of the wholesale market, published by the *Oil, Paint and Drug Reporter*, are the sources of the following averages. The quotations for both blood and ammonite were expressed in *units* of ammonia; these quotations have been recalculated on the assumption that a ton of these materials contains in each case fifteen *units*, or 300 pounds of potential ammonia.

WHOLESALE PRICE, PER TON, AT NEW YORK, DURING 1885.

MONTHS.	OF NITROGENOUS MATTER.								OF POTASH SALTS.			
	Nitrate of Soda.		Sulphate of Ammonia.		Azotine.		Dried Blood		Muriate of Potash.		Kainite.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
January	$45 00	$43 00	$65 00	$60 00	$32 25	$30 94	$30 75	$29 44	$34 00	$33 00	$7 68	$6 79
February..	45 00	42 75	65 00	60 00	33 75	32 25	31 50	30 75	34 50	33 25	8 50	7 13
March.....................	45 00	42 00	65 00	60 00	33 75	....	33 75	32 63	39 50	33 50	10 25	7 06
April	45 00	42 00	65 00	60 00	33 75	....	33 75	32 85	36 60	33 80	10 50	8 00
May.........................	45 00	42 75	65 00	60 00	33 75	....	35 81	34 50	37 75	33 75	11 00	7 44
June........................	45 00	42 00	65 00	60 00	33 75	....	35 25	34 50	35 00	33 50	9 56	7 23
July..........................	45 00	42 00	63 80	60 00	33 90	33 15	34 05	33 80	34 00	33 40	7 05	6 76
August.....................	46 75	45 00	62 70	60 00	33 75	33 00	34 50	33 75	34 75	33 12	7 00	6 70
September...............	49 40	47 00	62 40	60 00	33 75	33 00	33 75	32 76	35 00	33 00	7 40	6 85
October...................	51 50	48 00	62 40	60 00	33 75	33 00	34 81	33 56	35 00	33 00	7 50	7 06
November...............	50 00	48 00	62 40	60 00	33 75	33 00	35 06	34 81	35 00	33 50	7 63	7 18
December...............	50 00	48 00	62 60	60 00	34 65	33 90	35 25	34 50	35 00	33 50	8 50	7 27

PHOSPHORIC ACID.

The wholesale prices for phosphoric acid seem to have remained unchanged throughout the year, the quotation for acid phosphate having invariably been from "$12 to $15 per ton." The average analysis of sixteen samples, examined this year at this Station, is as follows:

Soluble Phosphoric Acid	9.18	per cent.
Reverted Phosphoric Acid	2.29	"
Insoluble Phosphoric Acid	3.65	"

At the average price of $13.50 per ton of acid phosphate, the wholesale prices per pound of phosphoric acid rule as follows:

	Cents.	
Soluble	5.62	per pound.
Reverted	5.	"
Insoluble	1.25	"

NITROGEN AND POTASH.

Nitrate of Soda	Averages	16	per cent.	nitrogen.
Sulphate of Ammonia.	"	20½	"	"
Dried Blood and Ammonite	"	12¼	"	"
Muriate of Potash	"	50	"	potash.
Kainite	"	12½	"	"

Based upon these analyses the average wholesale prices per pound of nitrogen and potash were as follows:

1885. MONTHS.	WHOLESALE COST PER POUND OF NITROGEN IN FORM OF—								WHOLESALE COST PER POUND OF POTASH IN—			
	Nitrate of Soda.		Sulphate of Ammonia.		Azotine.		Dried Blood		Muriate of Potash.		Kainite.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.
January	14.0	13.4	15.9	14.6	13.0	12.5	12.4	11.9	3.4	3.3	3.1	2.7
February	14.0	13.4	15.9	14.6	13.6	13.0	12.7	12.4	3.5	3.3	3.4	2.9
March	14.0	13.1	15.9	14.6	13.6	......	13.6	13.2	4.0	3.4	4.1	2.8
April	14.0	13.1	15.9	14.6	13.6	......	13.6	13.3	3.7	3.4	4.2	3.2
May	14.0	13.4	15.9	14.6	13.6	......	14.5	13.9	3.8	3.4	4.4	3.0
June	14.0	13.1	15.9	14.6	13.6	......	14.2	13.9	3.5	3.4	3.8	2.9
July	14.0	13.1	15.6	14.6	13.7	13.4	13.8	13.5	3.4	3.3	2.8	2.7
August	14.6	14.0	15.8	14.6	13.6	13.3	13.9	13.6	3.5	3.3	2.8	2.7
September	15.4	14.7	15.2	14.6	13.6	13.3	13.6	13.2	3.5	3.3	3.0	2.7
October	16.1	15.0	15.2	14.6	13.6	13.3	13.9	13.6	3.5	3.3	3.0	2.8
November	15.6	15.0	15.2	14.6	13.6	13.3	14.2	13.9	3.5	3.4	3.1	2.9
December	15.6	15.0	15.2	14.6	14.0	13.7	14.2	13.9	3.5	3.4	3.4	2.9
Av. for the year	14.3		15.2		13.4		13.6		3.5		3.2	

It is evident from this record that the *nitrogen* of nitrate of soda and dried blood has advanced in price since the beginning of the year; the nitrate by *eleven per cent.*, and the *blood* by *fourteen per cent.*

During the same period the wholesale price of the *nitrogen* in *sulphate of ammonia* has declined by approximately *seven* per cent., while that of the nitrogen in *azotine* has advanced by *seven* per cent.

Potash, in the form of muriate, has been subject to no marked fluctuations in price; the price of potash in the form of kainite, however, has varied widely, at the close being *ten per cent.* higher than it was at the beginning of the year.

The following table shows that the above statements also apply when the comparison is drawn between the average quotations for the last quarters of the years 1884 and 1885:

MONTHS.		AVERAGE WHOLESALE COST PER POUND OF NITROGEN IN FORM OF—								AVERAGE WHOLESALE COST PER POUND OF POTASH IN—			
		Nitrate of Soda.		Sulphate of Ammonia.		Azotine.		Dried Blood		Muriate of Potash.		Kainite.	
		1884.	1885.	1884.	1885.	1884.	1885.	1884.	1885.	1884.	1885.	1884.	1885.
January…… February…. March……..	Max..	14.6	14.0	16.0	15.9	13.9	13.4	13.5	12.9	3.4	3.6	3.3	3.5
	Min…	14.0	13.3	14.6	14.6	13.1	12.8	12.7	12.5	3.2	3.3	3.1	2.8
April……… May………… June…………	Max..	14.1	14.0	15.2	15.9	13.8	13.6	14.1	14.1	3.5	3.7	3.3	4.1
	Min…	13.3	13.2	14.3	14.6	13.4	……	13.4	13.7	3.3	3.4	3.0	3.0
July………… August……. September..	Max..	14.3	14.7	14.9	15.4	13.5	13.6	13.5	13.8	3.5	3.5	3.0	2.9
	Min…	13.6	13.9	14.4	14.6	13.2	13.3	12.6	13.4	3.3	3.3	2.9	2.7
October…… November.. December…	Max..	14.1	15.3	15.7	15.2	13.0	13.7	12.9	14.1	3.4	3.5	2.6	3.2
	Min…	13.5	15.0	14.5	14.8	12.6	13.4	11.9	13.8	3.2	3.4	2.6	2.9
Yearly Averages.	Max..	14.3	14.6	15.5	15.6	13.6	13.6	13.5	13.7	3.5	3.6	3.1	3.4
	Min…	13.6	13.9	14.5	14.7	13.1	13.2	12.7	13.4	3.3	3.4	2.9	2.9

2.

THE AVERAGE RETAIL PRICES OF NITROGEN, PHOSPHORIC ACID AND POTASH IN CRUDE STOCK FROM WHICH COMPLETE FERTILIZERS ARE MADE.

From time to time, during the spring and summer, the Station's chemist visited, without warning, the principal factories from which this State's supplies of fertilizers are drawn. All material found was carefully sampled, and the retail cash prices were obtained by letter from the manufacturers. After an analysis of the samples, therefore, it was not difficult to calculate the retail prices per pound of the various forms of nitrogen, phosphoric acid and potash used in this trade.

The tables upon the following pages furnish, in detail, the information gained by this work. They also show, to some extent, where fertilizer supplies may be purchased.

NITROGENOUS MATTERS.

In these tables nitrogenous materials have been classified as soluble and as insoluble in water. Under the first class may be found the *nitrates* and *ammonia salts;* under the second, dried blood, dried fish and various other forms of organic material. These supplies are almost invariably up to their guarantees. Instances have been known in other States where nitrate of soda has been adulterated with common salt, but such frauds are so easily detected that they now appear to be seldom attempted.

PHOSPHORIC ACID.

The superphosphates have been arranged with reference to the crude stock from which they were made. Those from bone black and bone ash being in the first table, and those from South Carolina rock and similar mineral phosphates in the second.

The phosphoric acid in dissolved bone black, and bone ash is, as a rule, almost entirely soluble in water. It is not liable to changes through reversion, and, consequently, these superphosphates seldom fall below their guarantees.

Mineral phosphates, on the other hand, contain considerable so-called reverted phosphoric acid. A difference of opinion exists as to what shall be understood by this term. In New Jersey it signifies combinations of phosphoric acid insoluble in water but soluble in citrate of ammonia solution at a *temperature not exceeding* 100° *Fahr.* In many other States 150° Fahr. is the limit, and in extreme cases 212° Fahr. has been used. Other things being equal, the higher the temperature the larger the quantity of reverted phosphoric acid; hence, differences between chemists on this determination are of frequent occurrence, and seriously affect the mineral phosphate industry. Acid phosphates reported to be above their guarantees in several States fall considerably below them when analyzed according to the law of New Jersey. This matter is now attracting considerable attention, and will again be noticed in this report.

POTASH SALTS.

In the purchase of muriate of potash increased caution is necessary, two particularly noticeable cases having recently been observed. The very low price, $34 per ton, of a salt guaranteed to contain eighty per cent. "muriate" caused suspicion, and sample 950 was sent to the Station for analysis. It was found to contain 12.12 per cent. only of actual potash, and in all probability represented a lot of kainite worth approximately $10 per ton.

In the second case a grange bought a quantity of "muriate," doubtless honestly guaranteed by the dealer to contain fifty-two per cent. of actual potash; the analysis indicated forty-two per cent. only of actual potash, making this material worth *seven dollars* per ton less than represented. Later developments have shown that this brand is known elsewhere—sold, however, under its correct guarantee of seventy per cent. "muriate."

Mr. Hamilton Salmon reports that *six hundred and fifty tons* of this low grade muriate were imported during the six months ending August 1st, 1885. During the same period 7,100 tons of the high grade, eighty per cent. muriate, were received, this being over *one thousand* tons less than receipts for the corresponding period in 1884. The total importation into the port of New York, during the year 1885, was 13,870 tons.

It will be noticed that in the tables the cost per pound of each kind of plant-food has been averaged. These averages have been collected and tabulated as follows:

	MANUFACTURERS' AVERAGE RETAIL PRICES FOR—	
	1884.	1885.
	cts.	cts.
Cost per pound of Nitrogen from Nitrate of Soda	16.9	16.1
" " " " " " Sulphate of Ammonia	17.1	16.7
" " " " " " Dried Blood	18.8	15.5
" " " " " " Dried Fish	....	14.8
" " " " " " Ammonite and Tankage	15.8	16.1
" " " " Soluble Phosphoric Acid from Bone Black	7.3	7.8
" " " " " " " " S. C. Rock	8.6	8.6
" " " " Reverted " " " Bone Black	6.7	6.9
" " " " " " " " S. C. Rock	7.8	7.6
" " " " Insoluble " " " Bone Black	2.9	1.7
" " " " " " " " S. C. Rock	1.9	1.9
" " " " Potash from High Grade Sulphate	....	6.7
" " " " " " Double Sulph's of Potash and Mag'a	7.2	6.8
" " " " " " Kainite	4.5	4.5
" " " " " " Muriate	4.2	4.1

These averages are the *manufacturers' retail cash prices for the nitrogen, phosphoric acid and potash in the crude stock from which complete fertilizers are made.*

FORMS OF NITROGEN

Readily and Completely Soluble in Water.

NITRATE OF SODA

FURNISHING.

Nitrogen in Form of Nitrates.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Nitrogen.	Cost of Nitrogen per lb.	Cost of 2,000 lbs. of Nitrate of Soda.
820	H. W. Doughten, Moorestown	16.10	cts. 15.9	$51 00
823	M. L. Shoemaker & Co., Philadelphia	16.24	14.6	47 50
836	Mapes' F. & P. Guano Co., New York	16.08	16.3	52 50
858	Geo. B. Forrester, New York	15.99	16.4	52 50
866	H. J. Baker & Bro., New York	16.04	16.4	52 50
874	Williams, Clark & Co., New York	16.36	15.9	52 00
881	Bowker Fertilizer Co., New York	16.31	16.9	55 00
970	E. Frank Coe, New York	16.33	15.9	52 00
980	Taylor Bros., Camden	16.44	16.7	55 00
	Average cost per pound of Nitrogen in Nitrate of Soda		16.1	....

SULPHATE OF AMMONIA

FURNISHING

Nitrogen in Form of Ammonia.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Nitrogen.	Cost of Nitrogen per lb.	Cost of 2,000 lbs. of Sulphate of Ammonia.
821	H. W. Doughten, Moorestown	20.19	cts. 16.8	$68 00
831	Lister Bros., Newark	20.64	15.7	65 00
841	M. L. Shoemaker, Philadelphia	20.56	15.8	65 00
857	Geo. B. Forrester, New York	21.18	17.1	72 50
865	H. J. Baker & Bro., New York	21.02	17.2	72 50
925	Baugh & Sons, Philadelphia	19.90	16.3	65 00
971	E. Frank Coe, New York	20.34	17.2	70 00
1028	Baugh & Sons, Philadelphia	20.50	17.7	70 00
	Average cost per pound of Nitrogen in Sulphate of Ammonia		16.7	....

FORMS OF NITROGEN INSOLUBLE IN WATER.

Dried Blood, Dried Fish, Ammonite and Tankage

FURNISHING

Nitrogen in Form of Organic Matter.

DRIED BLOOD.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Nitrogen.	Cost of Nitrogen per lb.	Cost of 2,000 lbs. of Dried Blood.
			cts.	
840	M. L. Shoemaker & Co., Philadelphia	14.00	13.6	$38 00
879	Williams, Clark & Co., New York	14.17	12.7	36 00
968	E. Frank Coe, New York	10.35	20.3	42 00
Average cost per pound of Nitrogen in Dried Blood			15.5	....

DRIED FISH.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage.		Cost Per Pound.		Cost of 2,000 lbs. of Fertilizer.
		Nitrogen.	Phosphoric Acid.	Nitrogen.	Phosphoric Acid.	
				cts	cts.	
878	Williams, Clark & Co., New York	9.10	6.76	13.7	6	$33 00
882	Bowker Fertilizer Co., New York	9.24	6.20	17.6	6	40 00
969	E. Frank Coe, New York	8.72	6.94	13.0	6	31 00
Average cost per pound of Nitrogen in Dried Fish				14.8	....	....

AMMONITE AND TANKAGE.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage.		Cost Per Pound.		Cost of 2,000 lbs. of Fertilizer.
		Nitrogen.	Phosphoric Acid.	Nitrogen.	Phosphoric Acid.	
				cts.	cts.	
842	M. L. Shoemaker & Co., Ammonite, A	14.21	1.77	14.4	6	$43 00
843	M. L. Shoemaker & Co., Ammonite, B	12.63	3.76	13.7	6	39 00
844	M. L. Shoemaker & Co., Swift Sure Guano	6.27	16.61	....	....	....
967	E. Frank Coe's Azotine	12.05	1.96	19.8	6	50 00
1029	Baugh & Son's AA Nitrogen	10.37	4.68	16.6	6	40 00
Average cost per pound of Nitrogen				16.1	....	....

PLAIN SUPERPHOSPHATES

Furnishing Soluble, Reverted and Insoluble Phosphoric Acid.

MANUFACTURED FROM

BONE BLACK, BONE ASH, ETC., ETC.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
818	Dissolved Bone Black..............	H. W. Doughten, Moorestown..	Chas. Collins, Fellowship.
822	Dissolved Bone Black..............	M. L. Shoemaker & Co., Philadelphia.	Assistant Chemist of Station.
833	Bone Black Superphosphate....	Lister Brothers, Newark.	Assistant Chemist of Station.
837	Bone Black Superphosphate ...	Mapes' F. and P. Guano Co., New York.	Assistant Chemist of Station.
858	Bone Black Superphosphate....	George B. Forrester, New York.	Chemist of Station.
860	Bone Black Superphosphate....	H. J. Baker & Bro., New York.	Chemist of Station.
877	Bone Black Superphosphate....	Williams, Clark & Co., New York.	Chemist of Station.
885	Bone Black Superphosphate.....	Bowker Fertilizer Co., New York.	Chemist of Station.
890	High Grade Superphosphate....	Mapes' F. and P. Guano Co., New York.	Chemist of Station.
916	Dissolved Bone Ash..................	M. L. Shoemaker & Co., Philadelphia.	Henry A. Hughes, Rio Grande.
978	Bone Black Superphosphate.....	E. Frank Coe, New York.	Chemist of Station.

FLOATS, PHOSPHORAL

And Precipitated Phosphate of Lime.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
825	Connetable Island Floats, No. II	Tropic Guano Co., New York.	Assistant Chemist of Station.
826	Phosphoral..............................	Tropic Guano Co., New York.	Assistant Chemist of Station.
884	Precipitated Phosphate of Lime	Elizabethport Glue Works.	Chemist of Station.
918	Connetable Island Floats, No. I	Tropic Guano Co., New York.	Assistant Chemist of Station.
1077	Precipitated Phosphate of Lime	Carteret Chemical Co., N. Y.	Chemist of Station.

PLAIN SUPERPHOSPHATES

Furnishing Soluble, Reverted and Insoluble Phosphoric Acid.

MANUFACTURED FROM

BONE BLACK, BONE ASH, ETC., ETC.

Station Number.	NAME AND ADDRESS OF MANUFACTURER.	Phosphoric Acid.					Cost per pound.			Cost of 2,000 pounds of Fertilizer.
					Available.		Phos. Acid.			
		Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Found.	Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	
							cts.	cts.	cts.	
818	H. W. Doughten, Moorestown......	17.32	0.53	0.28	17.85	18.00	7.10	6.30	1.60	$26 00
822	M. L. Shoemaker & Co., Phila.....	14.86	0.50	0.59	15.36	....	7.3	6.5	1.6	22 50
833	Lister Bros., Newark..................	17.66	0.99	0.58	18.65	....	6.9	6.2	1.5	26 00
837	Mapes' F. and P. Guano Co., N. Y.	12.75	5.05	0.79	17.80	17.00	8.3	7.4	1.9	29 00
853	Geo. B. Forrester, New York.......	17.43	0.18	0.18	17.61	....	8.2	7.3	1.8	29 00
860	H. J. Baker & Bro., New York.....	16.47	0.76	0.20	17.23	17.00	8.4	7.5	1.9	29 00
877	Williams, Clark & Co., New York	16.93	1.50	0.33	18.43	18.00	7.7	6.8	1.7	28 00
885	Bowker Fertilizer Co., New York	16.28	0.62	0.00	16.90	17.00	8.6	7.6	0.0	29 00
890	Mapes' F. and P. Guano Co., N. Y.	28.92	3.56	1.08	32.48	....	8.5	7.6	1.9	55 00
916	M. L. Shoemaker & Co., Phila......	17.01	1.02	0.12	18.03	....	7.8	6.9	1.7	28 00
973	E. Frank Coe, New York............	12.56	8.06	0.96	20.62	....	6.8	6.0	1.5	27 60
Average cost per pound of Phos. Acid from Bone Black.........							7.8	6.9	1.7	....

FLOATS, PHOSPHORAL

And Precipitated Phosphate of Lime.

Station Number.		Phosphoric Acid.					
		Total.	Soluble in Water.	Soluble in Ammonium Citrate at 40° C.	Insoluble in Ammonium Citrate at 40° C.	Soluble in Ammonium Citrate at 65° C.	Insoluble in Ammonium Citrate at 65° C.
825	Connetable Island Floats, No. II.......	26.44	....	1.25	25.19	2.81	23.63
826	**Phosphoral**....................................	**49.40**	....	**4.61**	**44.80**	**32.65**	**16.76**
834	Precipitated Phosphate of Lime........	27.26	....	23.66	3.60	....	....
913	Connetable Island Floats, No. I........	40.50	....	1.25	39.25	....	....
1077	Precipitated Phosphate of Lime........	24.16	0.58	23.20	0.38	23.16	0.42

PLAIN SUPERPHOSPHATES

Furnishing Soluble, Reverted and Insoluble Phosphoric Acid.

MANUFACTURED FROM

SOUTH CAROLINA ROCK AND OTHER MINERAL PHOSPHATES.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
817	Acid Phosphate	H. W. Doughten, Moorestown.	Chas. Collins, Fellowship.
859	Acid Phosphate	H. J. Baker & Bro., New York.	Chemist of Station.
861	Packard's Superphosphate	Packards, Ipswich, Eng., Sold by H. J. Baker & Bro., N. Y.	Chemist of Station.
873	Acidulated Phosphate	New Jersey Chemical Co., Camden.	A. A. Bateman, Moorestown.
875	Acid Phosphate from Land Rock	Williams, Clark & Co., New York.	Chemist of Station.
886	Acid Phosphate from River Rock	Bowker Fertilizer Co., New York.	Chemist of Station.
887	Acid Phosphate from Land Rock	Bowker Fertilizer Co., New York.	Chemist of Station.
917	English Superphosphate	Imported, Sold by L. T. Derousse, Camden.	Hon. I. W. Nicholson.
940	Diamond Soluble Bone	Walton, Whann & Co., New York.	Theo. F. Baker, Bridgeton.
972	Acid Phosphate	E. Frank Coe, New York.	Chemist of Station.
992	Soluble Bone Phosphate	Moro Phillips, Camden.	Henry I. Budd.
1002	Acid Phosphate	M. L. Shoemaker & Co., Philadelphia.	Henry I. Budd.
1037	Acid Phosphate	New Jersey Chemical Co., Camden.	Henry I. Budd.
1044	Philadelphia Standard Phos.	U. S. Chemical Co., Camden.	Henry I. Budd.
1046	Acidulated Phosphate Rock	Baugh & Sons, Philadelphia.	L. Mortimer, Vineland.
1065	Dissolved South Carolina Rock	J. E. Tygert & Co., Philadelphia.	Henry I. Budd.
1069	Dissolved Bone Phosphate	J. J. Allen's Sons, Philadelphia.	Henry I. Budd.

Agricultural chemists recognize three different classes of phosphates:

First—Those which dissolve in water.

Second—Those which dissolve in neutral solutions of citrate of ammonia.

Third—Those which are insoluble in both of the above-named fluids.

Phosphates belonging in the first and second classes are supposed to be readily assimilated by growing plants: to these phosphates, therefore, the name "*available*" has been given. In the superphosphate market, available phosphates only are regarded as valuable; insoluble phosphoric acid being ignored in all wholesale transactions.

As already stated in this Report, the warmer the solution of citrate of ammonia the larger will be the amount of phosphoric acid which it is able to dissolve; this makes it absolutely necessary that all determinations of "available" acid shall be carried out at a standard temperature. Until within a few years, 100° Fahr. was universally

PLAIN SUPERPHOSPHATES

Furnishing Soluble, Reverted and Insoluble Phosphoric Acid.

MANUFACTURED FROM

SOUTH CAROLINA ROCK AND OTHER MINERAL PHOSPHATES.

		Phosphoric Acid.					Cost per Pound.			
					Available.		Phos. Acid.			
Station number.	NAME AND ADDRESS OF MANUFACTURER.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Found.	Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Cost of 2,000 lbs. of Fertilizer.
817	*H. W. Doughten, Moorestown......	8.76	2.98	3.80	11.74	13.00	cts. 6.9	cts. 6.2	cts. 1.5	$17 00
859	*H. J. Baker and Bro., New York.	6.03	4.00	3.89	10.03	12.00	10.5	9.4	2.3	22 00
861	Packard's High Grade, from H. J. Baker & Bro.	37.94	4.12	1.87	42.06	40.00	9.5	8.4	2.1	80 00
873	N. J. Chemical Co., Camden	7.07	2.14	3.41	9.21	13.00	10.3	9.1	2.3	20 00
875	Williams, Clark & Co., New York.	10.21	0.28	1.13	10.49	10.00	7.5	6.6	1.7	16 00
886	Bowker Fertilizer Co., New York.	12.56	0.81	1.66	13.37	12.00	8.2	7.3	1.8	22 50
887	Bowker Fertilizer Co., New York.	10.68	1.37	2.41	12.05	12.00	9.1	8.0	2.0	22 50
917	English Superphosphate..............	13.36	0.76	1.24	14.12	....	6.3	5.6	1.4	18 00
940	Walton, Whann & Co., Wilmington	7.10	2.47	6.92	9.57	13.00	11.5	10.2	2.6	25 00
977	E. Frank Coe, New York.............	10.83	2.00	3.92	12.83	12.00	7.4	6.6	1.7	20 00
992	*Moro Phillips, Camden...............	10.56	1.03	2.47	11.59	12.00	6.7	5.9	1.5	16 00
1002	*M. L. Shoemaker & Co., Phila......	7.07	4.02	5.58	11.09	12.00	8.4	7.5	1.9	20 00
1037	*N. J. Chemical Co., Camden.......	10.21	1.97	3.49	12.18	13.00	9.8	8.7	2.2	25 00
1044	*U. S. Chemical Co., Camden.......	5.99	4.77	4.22	10.76	12.00	10.3	9.1	2.3	23 00
1046	Baugh & Sons, Philadelphia	7.80	2.30	5.29	10.10	10.00	7.3	6.4	1.6	16 00
1065	J. E. Tygert, Philadelphia...........	12.52	0.46	2.83	12.98	12.00	7.1	6.3	1.6	19 00
1069	J. J. Allen Sons, Philadelphia......	5.26	5.31	6.58	10.57	12.00	10.0	8.9	2.2	23 00
Average Cost per pound of Phos. Acid from S. C. Rock........							8.6	7.6	1.9	

* Tested at 150° Fahr. the available phosphoric acid found in this sample equals or exceeds its manufacturer's guarantee. The test, however, is illegal in New Jersey.

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admitted to be the proper limit, and phosphates soluble at this temperature were tested agriculturally and reported to be excellent plant food.

Now, however, it is believed that this test (100° Fahr.) excludes from the class "available," several valuable forms of phosphoric acid which dissolve readily in solutions of citrate of ammonia at 150° Fahr. Manufacturers urge that these forms deserve to be noticed, and most of our agricultural chemists therefore will this season adopt 150° Fahr. as their standard.

Consumers can, however, demand of Experiment Stations:

That all forms of phosphoric acid, for the first time classified as "available" under the 150° *test, shall be subjected to careful field trials and their agricultural values approximately determined.*

The analysis of a sample of *Phosphoral,* tabulated upon page 31, serves as an example under the first point. At 100° Fahr., Phosphoral yields less than *five per cent.* of available phosphoric acid, while at 150° Fahr. it yields nearly *thirty-three per cent.*

As far as known, no thorough trials of this phosphate have been made, and its agricultural value is still undetermined. It may, however, be freely used in complete fertilizers without attracting attention, and if these fertilizers are examined at 150° Fahr., their Phosphoric Acid will be valued commercially on the supposition that it was derived from thoroughly tested material.

The mechanical condition of Phosphoral is excellent; the supply of crude stock out of which it is made is very large, and the process of manufacture is simple and relatively inexpensive. The possibility that it may be a valuable fertilizer warrants the comparative field trials with it which this Station has this year carried out in nine counties of this State, reports of which may be found upon subsequent pages, under the heading of the Agricultural Relations of Fertilizers. There may be, however, other little known combinations of phosphoric acid similar to Phosphoral; it is now the duty of chemists to watch closely for such materials, and if detected to subject them to a thorough agricultural test.

Consumers can also demand:

That the schedules of official valuations shall be made to correspond with the change in the analytical methods.

In the schedule of trade values published later in this Report, phosphoric acid, soluble in citrate of ammonia, is quoted at *eight cents per pound.* This price was based upon the assumption that this determination was to be made at 100° Fahr.; any deviation from this method, therefore, should be followed by a corresponding change in the official valuation.

The available phosphoric acid in the seventeen samples of mineral superphosphates tabulated on page 33 was determined in each case, both at 100° and 150° Fahr.

Excluding sample 861, the average amount found at 100° Fahr. was 11.41 per cent., while at 150° Fahr. it was 12.75 per cent., an average increase in the available, and decrease in the insoluble of 1.34 per cent., equivalent to 26.8 pounds of phosphoric acid per ton of fertilizer.

The increase from 11.4 to 12.75 is equivalent to 11.7 per cent. of the available Phosphoric Acid; and as an increase in the quantity should be followed by a corresponding decrease in price, the schedule value of *eight cents* per pound of phosphoric acid, soluble in citrate of ammonia, should be reduced to *seven and one-tenth cents*, whenever the analysis is made at 150° Fahr.

Of these sixteen samples of mineral phosphates, nine fall below their guarantees when tested at 100° Fahr.; six of these, however, marked with * either equal or exceed their manufacturer's claims when the analyses are made at 150° Fahr.

GERMAN POTASH SALTS

Readily Soluble in Distilled Water.

MURIATE OF POTASH.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Potash.	Cost of Potash per pound.	Cost of 2,000 pounds of Muriate.
			cts.	
819	H. W. Doughten, Moorestown	42.84	4.6	$39 00
824	M. L. Shoemaker & Co., Philadelphia	52.58	3.7	39 00
832	Lister Bros., Newark	51.85	3.9	40 00
856	Geo. B. Forrester, New York	51.06	4.2	42 50
864	H. J. Baker & Bro., New York	50.96	4.2	42 50
876	Williams, Clark & Co., New York	53.14	4.0	42 50
888	Bowker Fertilizer Co., New York	54.82	4.2	46 00
914	Moro Phillips, Camden	52.28	4.3	45 00
975	E. Frank Coe, New York	55.64	3.6	40 00
979	Taylor Bros., Camden	48.92	4.6	45 00
Average cost of Potash per pound in Muriate		....	4.13	....
950	Terry Clancy, New Brunswick	12.12	....	$34 00

KAINITE.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Potash.	Cost of Potash per pound.	Cost of 2,000 pounds of Kainite.
			cts.	
829	M. L. Shoemaker & Co., Philadelphia	12.72	3.5	$9 00
863	H. J. Baker & Bro., New York	13.78	5.1	14 00
880	Williams, Clark & Co., New York	12.30	4.8	12 00
976	E. Frank Coe, New York	12.60	4.7	12 00
Average cost of Potash per pound in Kainite			4.5	....

POTASH SALTS.

Double Sulphates of Potash and Magnesia.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Potash.	Cost of Potash per pound.	Cost of 2,000 pounds of the Double Sulphate.
			cts.	
839	Mapes' F. and P. Guano Co., New York	26.26	6.7	$35 00
854	Geo. B. Forrester, New York	26.44	6.6	35 00
862	H. J. Baker & Bro., New York	24.80	7.0	35 00
889	Bowker Fertilizer Co., New York	24.92	6.9	34 50
974	E. Frank Coe, New York	26.11	6.7	35 00
Average Cost per pound of Potash			6.8	....

HIGH GRADE

Domestic Sulphate and "Bi-Sulphate" of Potash.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Potash.	Cost of Potash per pound.	Cost of 2,000 pounds of the High Grade Sulphate.
			cts.	
915	Moro Phillips, Domestic Sulphate	35.56	6.3	$45 00
855	G. B. Forrester's "Bi-Sulphate"	34.36	7.3	50 00
Average Cost per pound of Potash			6.8	....

3.

THE COMPARISON BETWEEN THE AVERAGE WHOLESALE AND RETAIL PRICES OF NITROGEN, PHOSPHORIC ACID AND POTASH IN CRUDE STOCK.

The conclusions reached in Sections 1 and 2 are here tabulated. They represent the manufacturers' *wholesale* and *retail* prices for plant food *in its best forms.* The percentages by which the retail prices exceed the wholesale, have been taken as the basis of the comparison.

	MANUFACTURERS' AVERAGE.		Average percentages by which the retail prices exceed the wholesale.
	Wholesale prices for 1885.	Retail prices for 1885.	
	cts.	cts.	per cent.
Nitrogen from Nitrate of Soda	14.3	16.1	12.5
" " Sulphate of Ammonia	15.2	16.7	9.86
" " Dried Blood	13.6	15.5	13.9
" " Dried Fish	....	14.8	....
" " Ammonite	13.4	16.1	20.19
Soluble Phosphoric Acid from Bone Black	....	7.8	....
" " " " S. C. Rock	5.62	8.5	51.24
Reverted " " " Bone Black	....	6.9	....
" " " " S. C. Rock	5.00	7.6	52.0
Insoluble " " " Bone Black	....	1.7	....
" " " " S. C. Rock	1.25	1.9	52.0
Potash from High Grade Sulphate	....	6.7	....
" " Double Sulph's of Potash and Magnesia	4.5	6.8	51.0
" " Kainite	3.2	4.5	40.62
" " Muriate	3.5	4.1	17.14

In the case of nitrogen, from all sources noted, and in the case of potash from the muriate, the differences between the *wholesale* and *retail* prices range from *ten to twenty* per cent. As regards kainite, the small amount of money involved in its purchase must be remembered, an increase of forty per cent. on its wholesale price amounting to less than *three dollars* per ton, while all expenses connected with its handling or storage are quite as heavy as they would be for nitrate of soda or any other high-priced supply.

No sufficient explanation is known for the excessive rates charged in retailing the double sulphate of potash and magnesia. The amount of this material imported during the twelve months ending January 1st, 1886, was *seven thousand five hundred and twenty-five tons.*

The retail prices of the different forms of phosphoric acid exceed the wholesale by more than fifty per cent. Business-like consumers, however, can easily find manufacturers who are content with one-half of this percentage; the classified list of samples of superphosphates published upon page 33 giving the necessary information on this point.

B.

THE GUARANTEED CHEMICAL COMPOSITION AND RELATIVE COMMERCIAL VALUES OF MERCHANTABLE FERTILIZERS.

AN ACT TO REGULATE THE MANUFACTURE AND SALE OF FERTILIZERS.

[Laws of New Jersey for 1874, page 90.]

1. That every commercial fertilizer which shall be offered for sale in this state shall be accompanied by an analysis, stating the percentage therein of ammonia, or its equivalent of nitrogen; of potash, in any form or combination, soluble in distilled water; and of phosphoric acid in any form or combination; the portion of phosphoric acid soluble in distilled water; that portion soluble in a neutral solution of citrate of ammonia at a temperature not exceeding one hundred degrees Fahrenheit; and that portion of phosphoric acid not soluble in either of the above-named fluids, shall each be determined separately; and the material from which the phosphoric acid is obtained shall also be stated; a legible statement of such analysis shall accompany all packages or lots of over one hundred pounds sold, offered or exposed for sale.

5. That any person selling, offering or exposing for sale any commercial fertilizer without the analyses required by the first section

of this act, or the act to which this act is a supplement, or with an analysis stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense; *provided further*, that the provisions of this section, or the act to which this act is a supplement, shall not apply to any manure sold at a price not exceeding one-half a cent per pound, nor to any imported guanos.

STATION'S METHOD OF CONTROLLING THE QUALITY OF FERTILIZERS.

Experience has demonstrated that the interests both of farmers and of reputable manufacturers, can be best protected:

1. By comparing the Station's analysis of a brand with its manufacturer's guarantee.

2. By distributing the published reports of these comparisons among producers and consumers.

3. By providing for an easy and fair comparison between the complete fertilizers from different works. This is done by the use of *relative commercial values*.

1.

THE STATION'S ANALYSES OF BRANDS.

Testing the correctness of the guarantees which fertilizer manufacturers are legally obliged to make, has now become one of the most important duties of this Station.

It is done by carefully sampling and analyzing all of the brands offered for sale in the State. The results are published in a manner which allows them to be readily obtained and easily understood by consumers, dealers and manufacturers.

Upon the following pages may be found the chemical composition and commercial valuations of—

107	brands of	Complete Fertilizers.
8	" "	Nitrogenous Superphosphates.
13	" "	Ground Bone.
3	" "	Superphosphates with Potash.
5	" "	Miscellaneous Fertilizers.

The officers of the Station drew the samples which represent seven of the above brands. With very few exceptions all other samples were secured by the following-named gentlemen, representative men among the farmers of this State:

THEO. F. BAKER, Bridgeton, Cumberland county.
ISAAC W. NICHOLSON, Haddonfield, Camden county.
HENRY I. BUDD, Mt. Holly, Burlington county.
J. S. GROVER, Red Bank, Monmouth county.
J. M. WHITE, New Brunswick, Middlesex county.

These gentlemen have done this service at the solicitation of the Station, with much inconvenience to themselves. Their work has increased, in a very noticeable manner, both the thoroughness and reliability of the State's control of fertilizers.

Before beginning this work each Inspector was provided with a copy of the following instructions:

DIRECTIONS TO BE OBSERVED IN SAMPLING FERTILIZERS.

Inspectors may sample fertilizers found either—

First—Upon farms;
Second—In dealers' storehouses, or,
Third—In manufactories.

The Station prefers that samples should be drawn either upon farms or in dealers' storehouses.

In sampling fertilizers found upon farms, Inspectors should ascertain—

First—That the farmer has received these fertilizers *during the present season;*
Second—That they were received in good condition, and have since been so stored that a noticeable gain or loss of moisture has been prevented.

In no case should farm samples be taken from stock of a past season or from stock which is or has been carelessly stored.

In sampling from *dealers' storehouses*, Inspectors should also ascertain whether the fertilizers are of old (last season's) or of new stock. Preference should always be given to the present season's goods. Circumstances may, however, make it advisable to sample old stock; in such cases, this fact should be distinctly stated by the Inspector, in his report to the Station's Director.

If for any reason it is found to be necessary to draw samples at factories, Inspectors should decline—

First—To sample from piles of fertilizers;
Second—To sample from bags which are not distinctly marked with the brand, the manufacturer's name and the guaranteed analysis.

If fertilizers are found stored in piles only, Inspectors should cause six or more bags to be filled from different portions of the piles; from these bags the samples may be drawn in the usual manner.

SAMPLING.

Whenever the mechanical condition will allow, samples should be drawn by means of the *sampling tube.*

This tube is formed to a sharp point at one end, and can be forced to the bottom of a bag or barrel. A slot extending nearly its entire length can then be opened and the tube allowed to fill with the fertilizer. When the slot is closed and the tube withdrawn, it will contain a fair sample of any given package.

It is not desirable to sample lots of less than one-half ton of any one brand. In such lots portions may be taken from each bag; in larger lots each fifth or tenth bag may be opened. The several portions representing the same brand should then be carefully mixed and a quart fruit-jar filled, securely closed and marked with labels furnished by the Station.

As soon as a sample has been taken, and *invariably* before bags of another brand have been opened, the Inspector should carefully fill out the blank describing samples.

He should copy *from the bags*—

First—The brand;
Second—The name of the manufacturer;
Third—The guaranteed analysis.

Any other information desired can be sought from the owner of the fertilizer.

Each sample bottle should be carefully wrapped in heavy paper, and packed for transportation in a wooden box, properly closed. This box should be forwarded by express, directed to

THE NEW JERSEY AGRICULTURAL EXPERIMENT STATION,
GEORGE H. COOK, DIRECTOR,
New Brunswick, N. J.

LABORATORY METHODS.

A State law provides definitely as to the manner in which several of the necessary chemical determinations shall be made. This law is rigorously obeyed in the Station's laboratory, but in cases where latitude is allowed the analysts, the methods recognized by the Association of American Chemists have been adopted with slight modifications. The laboratory rules require that all determinations shall be made in duplicate, that duplicates shall not be made upon the same day, and that whenever it is possible, duplicates shall be made by two radically different methods.

GUARANTEES.

As stated above, this season's list of complete fertilizers includes samples of one hundred and seven different brands. Of these, *fifty-*

nine contain more *nitrogen,* more *available phosphoric acid* and more *potash* than their manufacturers claim; while *five have been found below their guarantees in all respects.* Of the remaining forty-three samples, twenty-five contain an excess of *two,* and eighteen an excess of *one* only of the three above-mentioned elements. *Nitrogen* has been found to be below its guaranteed percentage in sixteen samples; potash has been found below its guarantee in twenty-two samples, and available phosphoric acid also has been found below its guarantee in twenty-two samples.

In more than one-half of the cases where available phosphoric acid has been found below its guarantee, it is well known that the cause lies in the analytical methods followed, manufacturers having based guarantees upon tests which are positively illegal in New Jersey. This point has been considered upon preceding pages of this Report.

As far as quantity of plant food is concerned, no proof of a deliberate attempt to defraud has been brought to light by this season's work—the differences between guarantees and Station's analyses being probably caused either by carelessness in factories, by irregularities in the composition of crude stock, or, as above noted in case of available phosphoric acid, by differences in analytical methods.

2.

PUBLICATION.

When results of importance have been secured they are published in bulletin form, and five thousand copies are circulated among the farmers and dealers of the State. Copies are also mailed to all of the State newspapers and to all manufacturers whose brands have been inspected.

During the past year three such bulletins have been issued:

No. XXXV. Devoted to Fertilizer Supplies.
" XXXVI. " " Complete Fertilizers.
" XXXVII. " " Ground Bone, Nitrogenous Superphosphates and Miscellaneous Fertilizers.

In these bulletins the Station's analyses were compared with the manufacturers' guarantees. As the analytical figures, however, were not expected to give all necessary information, even to chemists, it was considered advisable to publish the market value of the plant food found in each sample, and compare it with the manufacturer's retail cash price at his factory depot. For this purpose the following schedule of prices was arranged, by Station Directors and chemists, to be used in Massachusetts, Connecticut, New Jersey and Pennsylvania during the season of 1885:

SCHEDULE OF TRADE VALUES ADOPTED BY EXPERIMENT STATIONS FOR THE SEASON OF 1885.

	Cents per Pound.
Nitrogen in Ammonia Salts	18
" " Nitrates	18
" " Dried and fine ground fish	18
Organic Nitrogen in guano, dried and fine ground blood and meat	18
Organic Nitrogen in cotton seed and linseed meal and in castor pomace	18
Organic Nitrogen in fine ground bone	18
" " " fine medium bone	16
" " " medium bone	14
" " " coarse medium bone	12
" " " coarse bone, horn shavings, hair and fish scrap	10
Phosphoric Acid, soluble in water	9
" " soluble in ammonium citrate*	8
" " insoluble in dry, fine ground fish and in fine bone	6
" " insoluble in fine medium bone	5½
" " " " medium bone	5
" " " " coarse medium bone	4½
" " " " coarse bone	4
" " " " fine ground rock-phosphate	2
Potash as high grade sulphate	7¼
" " Kainite	4¼
" " Muriate	4¼

Nitrogen at 18c. per lb.
is equivalent to
Ammonia at 15c. per lb.

Before this schedule was used by this Station its accuracy was subjected to the following severe test: More than *eighty samples* of crude material, including all of the best sources of plant food, were collected, analyzed and the retail rates for their nitrogen, phosphoric acid and potash accurately determined. The schedule secured in the above manner of *manufacturers' average retail cash prices* for plant food in fertilizer supplies, has already been considered in detail in this report. In comparison with the Station's schedule it appears as follows:

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*The laws of this State direct that the temperature used in dissolving phosphates in ammonium citrate solution shall not exceed 100° Fahr.—*Laws of New Jersey for 1874, page 90.*

COMPARISON BETWEEN STATION'S SCHEDULE AND MANUFACTURERS' AVERAGE RETAIL PRICES OF PLANT FOOD IN FERTILIZER SUPPLIES.

	MANUFACTURERS' AVERAGE RETAIL PRICES FOR		STATION'S SCHEDULE OF PRICES FOR
	1884.	1885.	1885.
Cost per pound of Nitrogen from Nitrate of Soda	16.9c	16.1c	18c
" " " " " " Sulphate of Ammonia	17.1	16.7	18
" " " " " " Dried Blood	18.3	15.5	18
" " " " " " Dried Fish	......	14.8	18
" " " " " " Ammonite and Tankage	15.8	16.1	18
" " " " Soluble Phosphoric Acid from Bone Black	7.3	7.8	9
" " " " " " " " S. C. Rock	8.6	8.6	9
" " " " Reverted " " " Bone Black	6.7	6.9	8
" " " " " " " " S. C. Rock	7.8	7.6	8
" " " " Insoluble " " " Bone Black	2.9	1.7	2
" " " " " " " " S. C. Rock	1.9	1.9	2
" " " " Potash from High Grade Sulphate	......	6.7	7¼
" " " " " " Double Sulph's of Pot'h and Mag'a	7.2	6.8	7¼
" " " " " " Kainite	4.5	4.5	4¼
" " " " " " Muriate	4.2	4.1	4¼

It is apparent that, for the purposes for which it is intended, the Station schedule is quite as accurate as can reasonably be expected or desired.

In order to avoid misunderstandings in regard to the uses of this schedule, the following explanation has been published in all of the Station's fertilizer bulletins:

EXPLANATION OF THE STATION'S SCHEDULE.

Complete fertilizers and special manures are valued commercially upon the quality and quantity of the nitrogen, phosphoric acid and potash which they contain. A manufacturer may buy his nitrogen from one broker, his phosphoric acid from a second and his potash from a third. The crude materials containing these elements must then be transported to his factory, there mixed with each other in certain definite proportions, and then rebagged and shipped to consumers.

Station valuations are intended to represent the retail cash cost of the nitrogen, phosphoric acid and potash, *before the crude materials containing these elements have been mixed with each other to form a complete fertilizer.*

These valuations therefore are not intended to cover the expenses of mixing, bagging and transporting fertilizers from the factory to the farms. Such expenses depend upon the location of the works, the knowledge and facilities of the manufacturer, and the skill of his employes; conditions which cannot easily be estimated in dollars and cents. If, for example, the Station estimates the value of a given brand at $40 per ton, it means that for $40 a farmer can buy enough *unmixed material* to furnish the amount of nitrogen, phosphoric acid and potash, shown by analysis to be present in that brand. If the farmer wants to learn how much this brand should cost him when ready for the drill, he must add to the $40 the expenses of mixing the crude materials with each other, packing the mixture into bags and freighting it to his farm.

A PRACTICAL USE WHICH FARMERS MAY MAKE OF STATION VALUATIONS.

If the laws of this State are observed, every package of fertilizer offered for sale at ten dollars or more per ton will be distinctly marked with a guaranteed analysis. To be of any direct value, either to producers or consumers, there must be some rapid and easy method of interpreting these guarantees. This, it is claimed, may be accomplished by the use of the Station valuations. The guaranteed analyses of two brands will serve as illustrations. These brands have been offered for sale in this State during the past year.

MAIZE OLEINE.
GUARANTEED ANALYSIS.

Ammonia,	.75 to 1 per cent.
Phosphoric Acid,	3 to 5 per cent.
Potash,	3 to 3½ per cent.
Price, $30 per ton.	

MARROW BONE.
GUARANTEED ANALYSIS.

Ammonia,	.75 to 1 per cent.
Phosphoric Acid,	8 per cent.
Potash,	3 per cent.
Price, $30 per ton.	

According to the above guarantee, in 100 pounds of Maize Oleine the manufacturer offers his customers:

¾ of one pound of ammonia,	@ 15c.,	worth 11c.
3 pounds of phosphoric acid,	@ 9c.,	worth 27c.
3 pounds of potash,	@ 4¼c.,	worth 13c.
Total value of 100 lbs. of Maize Oleine,		51c.
Total value of 2,000 lbs. of Maize Oleine,		$10.20

In 100 pounds of Marrow Bone the manufacturer offers:

¾ of one pound of ammonia,	@ 15c.,	worth 11c.
8 pounds of phosphoric acid,	@ 9c.,	worth 72c.
3 pounds of potash,	@ 4½c.,	worth 13c.
Total value of 100 lbs. of Marrow Bone,		96c.
Total value of 2,000 lbs. of Marrow Bone,		$19.20

For $30, *therefore, this manufacturer offers an amount of plant food which can easily be purchased from other dealers, in an unmixed state, in one case for* $10.20, *and in the other for* $19.20.

The Station's analyses and valuations of these two brands may be found upon subsequent pages. In one case at least the guarantee was practically observed.

In cases of this kind legal redress is of course impossible; consumers must charge losses to their own lack of information. Such prices, however, for such brands will be unknown when farmers refuse to buy fertilizers if their selling prices differ noticeably from an estimated value computed from Station's prices and manufacturers' *minimum* guarantees. When the habit is acquired of making this calculation a necessary step in each purchase, great benefit will result both to consumers and reputable producers.

3.

A METHOD FOR COMPARING BRANDS FROM DIFFERENT MANUFACTORIES.

During the past year Station officials have learned that dealers, in selling their brands, at times resort to the following method of comparison:

A brand containing *two pounds* of nitrogen, *eight pounds* of phosphoric acid and *four pounds* of potash is said to have *fourteen pounds* of plant food in 100 pounds of fertilizer. Its agent claims that its price is therefore justly higher than that of a rival's brand, whose guarantee demands *thirteen pounds* of plant food only, made up, however, of *three pounds* of nitrogen, *eight pounds* of phosphoric acid and *two pounds* of potash.

This method of comparison is, of course, radically false, as it assumes that the three forms of plant food are equally expensive, where, in fact, nitrogen costs four times as much as potash.

Admitting that nitrogen is worth *eighteen cents*, available phosphoric acid *eight and one-half cents* and potash *four and a quarter* *cents* per pound, the *fourteen* pounds of plant food in one case could be bought for *one dollar and twenty-one cents*, or at the rate of $24.20 per ton of fertilizer. The *thirteen* pounds of plant food in the other case would, however, be worth *one dollar and thirty-one cents*, or $26.20 per ton of fertilizer.

Most farmers do not yet know positively the amounts of nitrogen, phosphoric acid and potash which they can profitably use. In purchasing fertilizers they are inclined to demand their "money's worth," but as a rule they do not insist that the quantities of plant food found by analysis shall correspond exactly with the manufacturers' guarantees; a slight deficiency in nitrogen, for instance, is not noticed, provided a sufficient excess of phosphoric acid or potash exists.

As long as this irrational condition of affairs continues, the Station's schedule of trade values furnishes the best standard for comparing the brands of different manufacturers. The manner in which this schedule may be used, has been already given in detail upon page 46, under the heading, *A Practical Use which Farmers may make of Station Valuations.*

All fertilizers, represented by analyses in the following tables, have been brought under this standard. One drawback to the use of this schedule on complete fertilizers lies in the inability of chemists at present to state definitely whether the organic nitrogen found in a certain sample came from high-priced blood or low-priced hair; whether the insoluble phosphoric acid is derived from bone, in which form it is worth four cents, or from South Carolina rock, in which it is worth two cents per pound only. Whenever the mechanical condition of fertilizers has warranted, therefore, the custom has been to credit manufacturers with the highest prices on the schedule, under the supposition that they use only the very best materials. Farmers, however, are cautioned that the only way in which they can be certain as to the sources of organic nitrogen and insoluble phosphoric acid, is to *buy the unmixed materials and make up complete fertilizers for themselves.* In this manner positive information as to the sources of plant food can be gained without involving any expense, provided that the mixture can be made by farmers at an outlay, for labor, which does not exceed five dollars per ton of mixed fertilizers. In many cases considerable money can be saved by observing this plan, as following calculations will show.

Approximately seventy of the analyses of complete fertilizers, published in following tables, have been classified, averaged and the retail market value of the plant food determined by using the *manufacturers' average retail prices for the year* 1885. These prices, it will be remembered, represent the average rate at which the *best* forms of nitrogen, phosphoric acid and potash can be bought at retail in fertilizer supplies.

	Average cost per ton of complete fertilizer.	Average cost of unmixed materials.	Average cost of mixing and retailing per ton.
Average of six samples, each containing three forms of Nitrogen, three forms of Phosphoric Acid and one form of Potash	$39 17	$32 91	$6 27
Average of seventeen samples, each containing two forms of Nitrogen, three forms of Phosphoric Acid and one form of Potash	33 32	26 81	6 51
Average of five samples, each containing one form of Nitrogen, three forms of Phosphoric Acid and one form of Potash	27 60	20 90	6 70
Average of sixteen samples, each containing two forms of Nitrogen, three forms of Phosphoric Acid and two forms of Potash	36 66	27 56	9 10
Average of thirteen samples, each containing two forms of Nitrogen, three forms of Phosphoric Acid and one form of Potash	37 30	25 27	12 03
Average of eight samples, each containing one form of Nitrogen, three forms of Phosphoric Acid and one form of Potash	31 37	18 08	13 29
Average of seven samples, each containing two forms of Nitrogen, three forms of Phosphoric Acid and one form of Potash	35 50	20 88	14 62

Under ordinary circumstances, it is probable that brands tabulated in the first three classes can be bought ready mixed as economically as they can be mixed upon the farm. Where this is the case, the positive knowledge that his plant food is of the highest grade will be one of the principal benefits derived by the farmer from mixing fertilizing materials for his own use.

Farmers, however, can save considerable sums of money by mixing fertilizers for themselves, whenever the only brands available can be included among those tabulated in the last four classes; especially as the highest prices are often charged for plant food drawn from the cheapest and least valuable sources.

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station number.
846	Ceres' Superphosphate	Ceres Manufacturing Co., Baltimore, Md.	Mortimer Whitehead, Middlebush, N. J.	846
849	Popular Phosphate	J. J. Allen's Sons, Philadelphia, Pa.	J. M. White, New Brunswick, N. J.	849
851	Potato Manure	" " " " "	" " " "	851
852	Ammoniated Bone	" " " " "	" " " "	852
1023	Fish Guano	" " " " "	J. S. Grover, Red Bank, N. J.	1023
1067	Allen's Nitro-Phosphate	" " " " "	H. I. Budd, Mt. Holly, N. J.	1067
1070	Soluble Marine Guano	" " " " "	" " " "	1070
850	Soluble Pacific Guano	Glidden & Curtis, Boston, Mass.	J. M. White, New Brunswick, N. J.	850
867	Clancy's Potato Manure	T. Clancy, New Brunswick, N. J.	" " " "	867
868	Clancy's Pure Bone Phosphate	" " " "	" " " "	868
893	Rose Bone Phosphate	Equitable Fertilizing Co., Baltimore, Md.	" " " "	893
1019	Special Esmeralda Guano	" " " " "	J. S. Grover, Red Bank, N. J.	1019
1050	Selected Esmeralda Natural Guano	" " " " "	H. I. Budd, Mt. Holly, N. J.	1050
894	Mapes' Nitrogenized Superphosphate	Mapes' F. and P. Guano Co., New York.	J. M. White, New Brunswick, N. J.	894
903	Mapes' "A" Brand	" " " " " "	J. S. Grover, Red Bank, N. J.	903
926	Mapes' Potato Manure	" " " " " "	Theo. F. Baker, Bridgoton, N. J.	926

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

		Nitrogen.					Phosphoric Acid.							Potash.					
												Available.							
Station number.		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
846	Ceres' Superphosphate	......	......	1.83	1.33	0.82	1.50	6.94	2.80	11.24	8.00	8.44	7.00	2.09	1.00	4.33	$22.61	$33.00	846
849	Allen's Popular Phosphate	......	......	0.47	0.47	0.62	1.77	5.00	7.37	14.14	9.00	6.77	6.00	1.36	2.50	3.36	19.93	....	849
851	" Potato Manure	......	1.78	1.04	2.82	2.87	5.41	2.23	4.87	12.51	12.00	7.64	8.00	5.58	7.50	5.62	32.10	....	851
852	" Ammoniated Bone	......	0.18	1.28	1.46	0.82	3.30	7.30	5.84	16.44	16.00	10.60	8.00	1.30	....	1.19	28.65	....	852
1023	" Fish Guano	......	0.53	1.98	2.46	2.46	4.84	1.47	5.49	11.80	....	6.31	6.00	1.46	1.35	2.94	25.54	....	1023
1067	" Nitro-Phosphate	......	2.20	0.99	3.19	1.23	3.30	3.96	7.05	14.31	....	7.26	9.00	1.72	2.50	2.07	30.86	....	1067
1070	" Soluble Marine Guano	......	3.37	1.67	5.04	3.28	4.19	1.82	3.90	9.91	....	6.01	6.00	4.03	2.06	4.44	35.14	....	1070
850	Glidden & Curtis' Soluble Pacific Guano	......	0.50	1.97	2.47	2.25	7.76	1.00	3.40	12.16	10.75	8.76	8.00	3.29	2.00	3.26	29.98	35.00	850
867	Clancy's Potato Manure	......	0.22	1.35	1.57	1.64	4.44	0.96	0.81	5.71	....	5.40	8.00	2.73	6.00	5.80	17.75	32.00	867
868	" Pure Bone Phosphate	......	0.23	1.31	1.54	1.64	3.22	1.90	0.61	5.76	....	5.12	8.00	1.95	2.00	3.98	16.55	30.00	868
893	Equitable Co.'s Rose Bone Phosphate	.....	......	0.45	0.45	Trace	4.15	3.84	4.98	12,97	11.00	7.99	10.00	1.54	2.00	1.98	20.53	28.00	893
1019	" " Special Esmeralda	0.66	0.08	1.50	2.24	2.05	0.50	4.64	10.58	15.72	15.00	5.14	6.00	1.61	2.00	2.82	26.21	40.00	1019
1050	" " Selected "	1.26	1.08	1.66	4.00	3.28	0.78	5.07	8.30	14.10	14.00	5.80	6.00	2.18	2.00	2.42	32.31	45.00	1050
894	Mapes' Nitrogenized Superphosphate	0.45	0.55	1.77	2.77	2.05	6.91	5.27	3.07	15.25	11.00	12.18	9.00	3.48	2.50	3.34	36.25	35.00	894
903	" "A" Brand	0.71	0.89	1.28	2.83	2.46	7.45	4.02	3.33	14.80	12.00	11.47	10.00	2.98	2.50	3.45	35.22	38.00	903
926	" Potato Manure	0.64	1.50	1.77	3.91	3.69	8.22	4.06	1.24	13.52	8.00	12.28	8.00	7.26	6.00	3.49	44.09	48.00	926

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station number.
956	Mapes' Corn Manure	Mapes' F. and P. Guano Co., New York.	H. I. Budd, Mt. Holly, N. J.	956
958	Mapes' Dried and Ground Fish	" " " " " "	" " " "	958
981	Mapes' Cauliflower and Cabbage Manure	" " " " " "	I. W. Nicholson, Camden, N. J.	981
1006	Mapes' Fruit and Vine Manure	" " " " " "	J. M. White, New Brunswick, N. J.	1006
899	Ammoniated Bone Phosphate	Bowker Fertilizer Co., N. Y.	J. S. Grover, Red Bank, N. J.	899
900	Ammoniated Dissolved Bone	" " " "	" " " " "	900
923	Bowker's Hill and Drill Phosphate	" " " "	I. W. Nicholson, Camden, N. J.	923
933	Stockbridge Potato Manure	" " " "	Theo. F. Baker, Bridgeton.	933
906	Americus Potato Fertilizer	Williams, Clark & Co., N. Y.	J. S. Grover, Red Bank.	906
908	Americus Ammoniated Bone Superphos	" " " "	" " " "	908
1095	Royal Bone	" " " "	J. M. White, New Brunswick, N. J.	1095
1096	Peach Tree Fertilizer	" " " "	" " " " "	1096
911	Chittenden's Complete Fertilizer for Potatoes	National Fertilizer Co., Bridgeport, Conn.	J. S. Grover, Red Bank, N. J.	911
944	Chittenden's Ammoniated Bone	" " " " "	Theo. F. Baker, Bridgeton.	944
945	Chittenden's Fish and Potato	" " " " "	" " "	945
918	Great Planet Formula "A"	Clark's Cove Guano Co., New Bedford, Mass.	I. W. Nicholson, Camden, N. J.	918

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
956	Mapes' Corn Manure	0.70	2.30	1.14	4.14	3.69	7.30	4.17	2.91	14.38	10.00	11.47	....	6.46	6.00	6.34	$42.52	$46.00	956
958	" Dried and Ground Fish	0.07	0.84	4.19	4.60	4.10	0.62	7.66	3.37	11.65	6.00	8.28	....	3.49	3.00	4.53	35.60	35.00	958
981	" Cabbage Manure	0.68	2.84	2.42	5.44	4.51	5.91	2.42	1.09	9.42	6.00	8.33	....	8.47	8.00	8.72	42.17	45.00	981
1006	" Fruit and Vine	0.29	0.80	1.02	2.11	1.64	6.26	3.00	0.77	10.03	7.00	9.26	....	11.27	11.00	1.16	39.72	40.00	1006
899	Bowker's Ammoniated Bone Phosphate	......	0.23	0.81	1.04	1.64	8.02	1.18	2.61	11.75	9.00	9.14	7.00	3.34	1.10	1.09	26.03	33.00	899
900	" " Dissolved Bone.	......	......	0.86	0.86	1.36	3.60	4.26	4.94	12.80	9.00	7.86	7.00	1.74	1.10	4.86	21.83	31.00	900
923	" Hill and Drill	......	0.44	1.95	2.39	2.50	9.45	0.23	1.66	11.34	11.00	9.68	8.00	1.60	2.00	1.85	28.67	36.00	923
933	" Potato Manure	......	0.88	2.54	3.42	3.28	6.68	0.56	1.11	8.35	8.00	7.24	....	7.92	7.00	5.59	33.15	43.00	933
906	Williams, Clark & Co.'s Potato Fertilizer	1.11	......	2.07	3.18	2.46	5.22	0.86	0.14	6.22	6.00	6.08	5.00	8.02	8.00	0.98	33.19	45.00	906
908	Williams, Clark & Co.'s Americus Am. Bone Superphos.	0.10	......	1.80	1.90	1.64	7.17	1.44	1.78	10.34	10.00	8.61	9.00	2.18	2.00	0.39	26.28	36.00	908
1095	Williams, Clark & Co.'s Royal Bone	......	0.09	1.27	1.36	0.82	0.34	6.96	6.68	13.98	7.00	7.30	6.00	2.24	2.00	2.18	23.89	25.00	1095
1096	Williams, Clark & Co.'s Peach Tree Fertilizer	......	......	0.20	0.20	....	8.15	4.67	1.29	9.11	....	7.82	6.00	5.85	5.00	0.71	22.81	26.00	1096
911	Chittenden's Complete Fertilizer	......	0.23	3.45	3.68	3.28	7.49	0.28	1.21	8.98	8.00	7.77	6.00	5.20	6.00	4.21	32.58	42.00	911
944	" Ammoniated Bone	......	0.14	1.92	2.06	1.64	7.49	0.51	1.09	9.09	9.00	8.00	8.00	2.26	1.50	2.19	24.51	32.00	944
945	" Fish and Potash	......	0.09	3.77	3.86	3.28	2.27	2.97	1.29	6.53	6.00	5.24	....	4.24	4.00	8.12	27.37	32.00	945
918	Clark's Cove Formula "A"	1.41	0.63	2.22	4.26	3.29	6.41	0.85	1.32	8.58	8.25	7.26	7.00	9.38	9.50	7.10	37.26	45.00	918

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station number.
919	Great Planet Formula "B"	Clark's Cove Guano Co., New Bedford, Mass.	I. W. Nicholson, Camden, N. J.	919
920	Unicorn	" " " " " "	" " " "	920
1054	King Philip	" " " " " "	H. I. Budd, Mt. Holly, N. J.	1054
1056	Bay State	" " " " " "	" " " "	1056
921	No. 1 Peruvian Guano, Lobos		I. W. Nicholson, Camden, N. J.	921
984	No. 1 Peruvian Guano		" " " "	984
922	Fish Guano.	James E. Otis, Tuckerton, N. J.	" " " "	922
928	Lister's Standard	Lister Bros., Newark, N. J.	Theo. F. Baker, Bridgeton, N. J.	928
1045	Potato Fertilizer	" " " "	Chemist of Station.	1045
1074	Ammoniated Dissolved Bone	" " " "	H. I. Budd, Mt. Holly, N. J.	1074
1088	U. S. Superphosphate	" " " "	J. M. White, New Brunswick, N. J.	1088
929	Harvest Pride	A. W. South, Philadelphia, Pa.	Theo. F. Baker, Bridgeton, N. J.	929
982	Phuine	Moro Phillips, Camden, N. J.	" " " "	982
993	Moro Phillips' Superphosphate of Lime	" " " "	H. I. Budd, Mt. Holly, N. J.	993
987	Quaker City Poudrette	Quaker City Poudrette Co., Philadelphia, Pa.	Theo. F. Baker, Bridgeton. N. J.	987
989	Echo Superphosphate	M. L. Shoemaker & Co., Philadelphia, Pa.	" " " "	989

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
												Available.							
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.				
919	Clark's Cove Formula "B"........	2.55	1.34	0.92	4.81	4.94	4.61	0.79	0.92	6.32	6.00	5.40	5.00	8.27	7.00	1.76	$38.21	$46.00	919
920	" " Unicorn........	......	0.14	2.29	2.43	1.84	8.06	1.18	2.51	11.75	8.50	9.24	8.50	2.62	2.25	1.34	29.89	33.00	920
1054	" " King Philip........	......	0.10	1.21	1.31	1.23	5.41	2.26	2.95	10.62	....	7.67	6.50	5.02	3.00	1.38	26.61	28.00	1054
1056	" " Bay State........	0.36	0.67	2.00	3.03	2.46	9.10	1.00	1.54	11.64	....	10.10	10.00	3.32	2.00	2.38	33.03	38.00	1056
921	No. 1 Peruvian Guano, Lobos........	0.12	2.77	0.73	3.62	4.10	2.53	8.32	5.76	16.61	14.00	10.85	....	2.93	2.00	2.22	38.00	48.00	921
984	Peruvian Guano, No. 1........	0.21	4.29	1.20	5.70	7.38	2.42	8.72	4.58	15.67	12.00	11.14	....	2.89	2.00	1.85	45.16	....	984
922	J. E. Otis' Fish Guano........	......	0.16	6.09	6.25	4.10	0.96	3.43	0.45	4.84	7.00	4.39	....	4.10	2.00	4.51	33.56	33.00	922
928	Lister's Standard........	......	0.94	1.74	2.68	2.33	8.37	2.58	1.41	12.36	12.00	10.95	10.00	2.14	1.50	1.17	32.11	36.00	928
1045	" Potato Fertilizer........	......	2.52	1.53	4.05	3.69	9.60	0.08	0.12	9.80	....	9.68	6.00	7.39	7.00	8.09	38.37	45.00	1045
1074	" Am. Dissolved Bone........	......	0.66	1.59	2.25	1.64	6.99	3.45	1.08	11.52	10.00	10.44	8.00	1.95	1.50	0.40	29.57	31.50	1074
1088	" U. S. Superphosphate........	......	0.39	1.00	1.39	1.31	5.22	1.23	0.59	7.04	7.00	6.45	6.00	2.61	2.00	6.55	19.06	27.90	1088
929	A. W. South's Harvest Pride........	.....	0.21	1.85	2.06	0.82	5.33	2.89	2.94	11.16	11.46	8.22	....	2.42	2.00	5.68	26.04	30.00	929
932	Moro Phillips' Phuine........	......	0.13	1.96	2.09	1.64	5.14	1.38	8.92	10.44	7.00	6.52	....	2.26	2.00	0.86	24.71	35.00	932
993	" " Superphos. of Lime........	......	0.05	2.14	2.19	1.64	9.14	0.42	0.96	10.52	14.68	9.56	10.00	2.83	2.16	0.71	29.31	35.00	993
937	Quaker City Poudrette........	0.15	0.34	1.84	1.83	1.23	0.87	8.49	0.88	4.74	6.00	4.36	....	0.36	3.00	0.37	14.35	22.00	937
939	M. L. Shoemaker & Co.'s Echo........	......	......	1.32	1.32	0.82	4.61	2.87	4.40	11.88	9.00	7.48	7.00	1.94	1.00	4.18	22.81	25.00	939

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station number.
987	Swift Sure Superphosphate	M. L. Shoemaker & Co., Philadelphia.	I. W. Nicholson, Camden, N. J.	987
995	$23 Phosphate	" " " "	H. I. Budd, Mount Holly, N. J.	995
1000	Good Enough Superphosphate	" " " "	" " " "	1000
943	Star Bone Phosphate	J. E. Tygert & Co., Philadelphia, Pa.	Theo. F. Baker, Bridgeton.	943
948	Tip Top Superphosphate	I. P. Thomas, " "	" " "	948
949	Virginius Guano	Powell, Morse & Co., Hoffman's Wharf, Va.	" " "	949
951	Corn Fertilizer	John Taylor, Trenton, N. J.	H. I. Budd, Mount Holly, N. J.	951
1092	Complete Fertilizer for Fruit Trees	" " " "	J. M. White, New Brunswick, N. J.	1092
1093	Complete Fertilizer	" " " "	" " " "	1093
1094	Complete Fertilizer for Truck and Tobacco	" " " "	" " " "	1094
1114	Complete Fertilizer for Wheat	" " " "	Director of Station.	1114
953	Ammoniated Bone Superphosphate	H. Preston & Sons, Greenpoint, L. I.	H. I. Budd, Mount Holly, N. J.	953
954	Doughten's Dried and Ground Fish Guano	" " " "	" " " "	954
1100	Ammoniated Bone Superphosphate	" " " "	J. M. White, New Brunswick, N. J.	1100
955	Doughten's Potato Manure	H. W. Doughten, Moorestown, N. J.	H. I. Budd, Mount Holly, N. J.	955

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.					
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.				Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
												Found.	Guaranteed.	Found.	Guaranteed.				
987	M. L. Shoemaker & Co., Swift Sure Superphos.	0.60	0.07	2.59	3.26	2.46	7.41	4.14	2.61	14.16	14.00	11.55	9.00	4.39	4.00	4.06	37.52	36.00	987
995	M. L. Shoemaker & Co., $23 Phosphate	......	......	1.22	1.22	0.82	5.33	2.63	2.97	10.93	8.00	7.96	6.00	2.64	1.00	5.67	22.81	23.00	995
1000	M. L. Shoemaker & Co., Good Enough	......	0.14	1.78	1.87	1.23	6.34	3.31	4.07	13.72	12.00	9.65	8.00	2.09	1.62	1.92	28.48	33.00	1000
943	Tygert & Co., Star Bone Phos.	......	......	1.61	1.61	1.75	7.72	1.15	2.19	11.06	......	8.87	9.00	2.86	2.25	4.59	25.72	33.00	943
948	I. P. Thomas, Tip Top Superphosphate	0.34	......	1.77	2.11	2.05	6.45	2.98	4.83	14.26	13.00	9.43	10.00	2.09	2.75	2.28	29.62	36.00	948
949	Powell, Morse & Co., Virginius Guano	......	0.51	2.63	3.14	3.28	1.08	6.04	3.07	10.19	9.00	7.12	7.00	1.61	1.00	2.51	26.74	38.00	949
951	Taylor's Corn Manure	......	0.18	3.50	3.68	3.28	1.72	8.21	4.58	14.46	11.00	9.93	......	5.04	5.00	5.80	37.39	35.00	951
1092	Taylor's Complete Fertilizer for Fruit Trees	......	......	0.92	0.92	1.23	4.65	3.83	4.68	13.11	9.00	8.48	......	11.69	10.00	11.48	31.43	32.00	1092
1093	Taylor's Complete Fertilizer for Oats	......	1.01	2.04	3.05	2.87	1.46	4.69	3.99	10.14	10.00	6.15	......	3.53	2.50	6.16	27.30	34.00	1093
1094	Taylor's Complete Fertilizer for Tobacco, Potatoes and Truck	......	0.16	2.83	2.99	2.46	5.41	6.30	1.91	13.62	11.00	11.71	......	10.06	10.00	10.07	40.66	45.00	1094
1114	Taylor's Complete Fertilizer for Wheat	......	0.95	1.94	2.89	3.28	7.68	2.48	4.82	14.98	12.00	10.16	......	3.03	2.50	4.66	34.63	34.00	1114
953	Doughten's Am. Bone Superphosphate	......	0.14	2.08	2.22	2.05	7.56	1.39	1.68	10.63	......	8.95	9.00	1.98	......	4.67	26.85	......	953
954	Doughten's Dried and Ground Fish Guano	......	1.00	3.46	4.46	4.10	1.95	3.54	1.01	6.50	5.04	5.49	......	0.30	......	2.69	26.30	30.00	954
1100	Preston's Am. Bone Superphos.	......	0.18	2.43	2.61	2.50	7.76	1.57	2.16	11.49	11.00	9.33	10.00	1.22	2.00	2.83	28.65	30.00	1100
955	Doughten's Potato Manure	......	1.92	1.31	3.23	3.28	7.72	0.66	1.78	10.11	8.00	8.38	7.00	6.02	6.00	5.97	33.08	43.00	955

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station number.
960	Gaskill's High Grade Manure	J. C. Gaskill, Birmingham, N. J.	H. I. Budd, Mount Holly, N. J.	960
961	Gaskill's Special Fish Manure	" " "	" " " "	961
962	Gaskill's Popular Phosphate	" " "	" " " "	962
978	Farmers' Favorite Phosphate	Simons & Boutcher, Andalusia, Bucks Co., Pa.	Theo. F. Baker, Bridgeton, N. J.	978
985	La Vuelta Guano	L. N. & J. S. Hopkins, Baltimore, Md.	I. W. Nicholson, Camden, N. J.	985
986	Plow Brand Raw Bone Phosphate	Walton, Whann & Co., Wilmington, Del.	" " " "	986
1005	Excelsior Guano	E. Frank Coe, New York.	J. M. White, New Brunswick, N. J.	1005
1011	Alkaline Bone	" " "	J. S. Grover, Red Bank.	1011
1013	Ralston's Knickerbocker Ammoniated Bone Superphos.	" " "	" " "	1013
1015	Peach Tree Fertilizer	" " "	" " "	1015
1098	High Grade Ammoniated Bone	" " "	J. M. White, New Brunswick, N. J.	1098
1099	Ralston's Potato Fertilizer	" " "	" " " "	1099
1125	High Grade Ammoniated Bone	" " "	Assistant Chemist of Station.	1125
1008	Union Co. Fertilizer	Theo. Glaser, Linden, N. J.	J. M. White, New Brunswick, N. J.	1008
1018	A. A. Ammoniated Superphosphate	H. J. Baker & Bro., New York.	J. S. Grover, Red Bank.	1018

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
												Available.							
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.				
960	Gaskill's High Grade Manure.	......	2.43	1.09	3.52	3.28	8.21	0.38	0.52	9.11	8.00	8.59	6.00	7.89	6.00	8.47	$35.18	....	960
961	" Special Fish Manure	......	0.10	2.44	2.54	2.46	4.92	1.99	1.64	8.55	8.00	6.91	6.00	5.13	4.00	7.52	26.86	....	961
962	" Popular Phosphate	......	0.26	1.45	1.71	1.64	8.45	0.73	1.16	10.34	8.00	9.18	7.00	1.61	2.09	4.71	24.83	....	962
978	Simons & Boutcher, Farmers' Favorite Phosphate	......	0.16	1.30	1.46	1.85	2.23	4.77	3.90	10.90	9.50	7.00	7.00	2.13	2.75	4.77	21.83	$35.00	978
985	Zell's La Vuelta	0.49	1.37	0.44	2.30	2.05	5.16	1.51	2.16	8.83	7.00	6.67	6.00	7.83	6.00	11.61	28.38	40.00	985
986	Walton, Whann & Co.'s Plow Brand	......	0.11	2.15	2.26	1.85	6.37	2.66	4.85	13.38	11.00	9.03	9.00	2.24	2.00	2.36	29.24	35.00	986
1005	Coe's Excelsior Guano	......	1.25	2.48	3.68	3.28	9.02	1.58	1.61	12.21	10.00	10.60	....	2.76	2.70	0.41	36.98	43.00	1005
1011	" Alkaline Bone	......	0.14	1.04	1.18	0.82	7.37	1.85	3.58	12.80	10.00	9.22	9.00	1.91	1.62	0.38	25.81	27.00	1011
1013	" Ralston's Knickerbocker	......	0.55	1.75	2.26	1.64	8.52	1.09	2.88	12.49	....	9.61	8.00	1.34	1.08	0.34	29.19	32.00	1013
1015	" Peach Tree Fertilizer	......	0.15	1.38	1.53	0.82	7.07	1.22	3.13	11.42	....	8.29	6.00	4.95	4.86	0.67	29.34	27.00	1015
1098	" High Grade Am. Bone	......	0.19	2.01	2.20	2.05	7.72	0.98	3.28	11.98	10.00	8.70	9.00	1.51	1.08	0.42	27.86	32.00	1098
1099	" Ralston's Potato Fertilizer	......	0.13	1.17	1.30	1.64	7.95	1.28	2.03	11.26	....	9.23	8.00	5.06	3.78	0.52	29.59	39.50	1099
1125	" High Grade Am. Bone	......	0.51	1.70	2.21	2.05	7.80	1.17	4.44	13.41	10.00	8.97	9.00	1.15	1.08	0.30	28.85	32.00	1125
1008	Theo. Glaser, Union Co. Fertilizer	......	0.24	0.91	1.15	1.64	4.65	0.98	5.58	11.21	10.00	5.63	....	1.75	2.00	4.45	20.03	25.00	1008
1018	Baker's AA Ammoniated	......	2.60	0.74	2.74	2.46	10.67	0.69	0.13	11.49	....	11.36	10.00	2.98	2.00	3.54	32.79	37.50	1018

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station number.
1025	Turnip Manure	H. J. Baker & Bro., New York	J. S. Grover, Red Bank, N. J.	1025
1026	Potato Manure	" " " "	" " " "	1026
1032	High Grade Tobacco and Grain Manure	Baugh & Son, Philadelphia, Pa.	H. I. Budd, Mount Holly, N. J.	108
1036	Button Bone	N. J. Chemical Co., Camden, N. J.	" " " " "	1036
1038	Yarnell's High Grade Phosphate	" " " " "	" " " " "	1038
1039	Yarnell's Bone Fertilizer	" " " " "	" " " " "	1039
1040	Acidulated Fish Guano	" " " " "	" " " " "	1040
1041	W. and C. Superphosphate	" " " " "	" " " " "	1041
1057	Acidulated Fish Guano	" " " " "	" " " " "	1057
1042	National Superphosphate	U. S. Chemical Co., Camden, "	" " " " "	1042
1043	National Tobacco	" " " " "	" " " " "	1043
1048	National Potato	" " " " "	" " " " "	1048
1052	Soluble Tampico Guano	Sharpless & Carpenter, Philadelphia, Pa.	" " " " "	1052
1102	No. 1 Bone Phosphate	" " " " "	J. M. White, New Brunswick, N. J.	1102
1060	Marrow Bone	Alexander G. Cummings, Smyrna, Del.	H. I. Budd, Mount Holly, N. J.	1060

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
												Available.							
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.				
1025	Baker's Turnip Manure	......	4.93	0.50	5.43	5.74	4.76	0.67	0.17	5.60	....	5.43	5.00	9.03	9.00	0.56	41.98	48.50	1025
1026	" Potato Manure	0.13	3.25	0.72	4.10	3.28	6.18	0.54	0.12	6.84	....	6.72	5.75	8.62	10.00	2.30	37.49	45.00	1026
1032	Baugh & Sons' High Grade Grain and Tobacco	......	1.14	3.15	4.29	4.10	3.57	2.27	3.79	9.63	....	5.84	5.00	2.20	2.16	4.22	30.40	35.00	1032
1036	N. J. Chemical Co., Button Bone	......	1.13	0.81	1.94	1.23	5.38	2.96	3.46	11.80	11.50	8.34	10.00	3.25	2.50	4.92	26.93	36.00	1036
1038	N. J. Chemical Co., Yarnell's High Grade Phos	......	0.97	2.40	3.37	3.28	7.30	1.69	1.81	10.80	....	8.99	10.00	4.56	5.00	3.96	33.30	....	1038
1039	N. J. Chemical Co., Yarnell's Bone Fertilizer	......	0.45	1.36	1.81	1.64	6.60	2.05	3.99	12.64	....	8.65	11.00	2.51	3.00	2.46	27.00	....	1039
1040	N. J. Chemical Co., Acidulated Fish Guano	......	0.35	1.76	2.11	2.05	6.30	1.85	4.23	11.88	12.00	7.65	10.00	2.00	1.50	1.63	26.18	37.00	1040
1041	N. J. Chemical Co., W. & C. Superphos.	......	0.65	1.37	2.02	1.64	6.37	1.47	5.06	12.90	....	7.84	11.00	2.42	1.00	2.99	27.20	37.00	1041
1057	N. J. Chemical Co., Acidulated Fish Guano	......	0.33	1.79	2.12	2.05	6.50	1.34	4.04	11.88	....	7.84	10.00	1.53	1.50	1.53	26.00	37.00	1057
1042	U. S. Chemical Co., National Superphos	......	......	1.21	1.21	1.64	7.10	4.18	3.11	14.39	13.00	11.28	....	2.08	2.00	2.15	28.10	33.00	1042
1043	" " " " Tobacco	......	......	2.00	2.00	1.64	3.61	3.39	4.36	11.36	....	7.00	8.00	1.92	3.00	3.86	24.24	38.00	1043
1048	" " " " Potato	......	......	1.84	1.84	1.64	3.46	3.26	4.54	11.26	....	6.72	8.00	1.70	3.00	3.11	23.15	35.00	1048
1052	Sharpless & Carpenter, Soluble Tampico Guano	......	0.25	2.42	2.67	2.46	7.14	1.39	1.74	10.27	....	8.53	8.00	4.36	5.00	4.06	29.78	40.00	1052
1102	Sharpless & Carpenter, No. 1 Bone Phos.	......	......	1.70	1.70	1.23	3.95	2.87	2.91	9.73	....	6.82	6.00	2.21	1.50	5.71	22.02	25.00	1102
1060	A. G. Cummings' Marrow Bone	......	......	0.32	0.32	0.62	1.34	1.59	2.42	5.35	8.00	2.93	....	2.07	3.00	5.39	9.80	30.00	1060

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station number.
1061	Maize Oleine	Alexander G. Cummings, Smyrna, Del.	H. I. Budd, Mount Holly, N. J.	1061
1071	Ammoniated Bone Superphosphate	J. Richmond, Philadelphia, Pa.	" " " " "	1071
1072	Excelsior	" " " "	" " " " "	1072
1082	Potato Manure	Geo. B. Forrester, Brooklyn, L. I.	Abm. W. Duryee, New Durham, N. J.	1082
1083	Cabbage Manure	" " " "	" " " " "	1083
1084	Corn Manure	" " " "	" " " " "	1084
1085	High Grade Farmers' Friend, Special for Corn	Read & Co., New York.	J. M. White, New Brunswick, N. J.	1085
1104	Farmers' Friend, Special for Wheat and Rye	" " "	" " " "	1104
1086	The Reaper	Farmers' Fertilizing Co., Syracuse, N. Y.	" " " "	1086
1110	Equine	Wenderoth & Sons, Camden, N. J.	I. W. Nicholson, Camden, N. J.	1110
1111	Potato Fertilizer	" " " "	" " " "	1111
1112	Ammoniated Bone Superphosphate	Crocker Fertilizer Co., Buffalo, N. Y.	J. S. Grover, Red Bank, N. J.	1112
1122	Bradley's Superphosphate	Bradley Fertilizer Co., Boston, Mass.	Assistant Chemist of Station.	1122
1123	W. F. Allen's Complete Phosphate		Henry E. Hale, Princeton, N. J.	1123

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
1061	A. G. Cummings' Maize Oleine	......	......	0.35	0.35	0.62	0.96	0.88	1.16	3.00	3.00	1.84	....	2.70	3.00	6.81	$7.63	$30.00	1061
1071	J. Richmond's Am. Bone Superphos.	......	0.18	2.25	2.43	2.05	7.26	1.46	3.90	12.62	12.00	8.72	9.00	1.96	1.08	1.81	28.94	33.00	1071
1072	" Excelsior	......	1.11	2.81	3.92	3.28	10.14	0.43	0.95	11.52	12.00	10.57	10.00	3.43	2.70	3.50	36.73	45.00	1072
1082	G. B. Forrester, Potato Manure	......	3.89	0.03	3.92	3.50	8.02	0.35	0.15	8.52	....	8.37	5.25	9.67	10.00	3.08	40.77	45.00	1082
1083	" " Cabbage Manure	......	5.28	0.03	5.31	4.72	5.37	1.78	0.87	8.02	....	7.15	5.00	8.28	7.00	0.72	43.76	47.00	1083
1084	" " Corn Manure	......	4.41	0.07	4.48	3.90	9.68	0.16	0.06	9.90	....	9.84	6.50	10.13	8.00	7.88	42.47	45.00	1084
1085	Read & Co.'s High Grade Farmers' Friend, Special for Corn	......	2.98	0.79	3.77	3.28	6.34	3.90	2.43	12.67	11.00	10.24	8.00	8.36	8.00	3.39	40.27	37.00	1085
1104	Read & Co., Farmers' Friend, Special for Wheat and Rye	......	0.10	2.74	2.84	2.05	7.72	2.00	1.92	11.64	11.00	9.72	8.00	3.29	3.00	3.35	31.66	27.00	1104
1086	Farmers' Fert'ing Co.—The Reaper	......	......	0.97	0.97	0.82	3.07	3.67	2.34	9.08	8.00	6.74	6.00	3.09	4.32	7.56	19.39	25.00	1086
1110	Wenderoth & Sons' Equine	......	0.11	2.22	2.33	2.05	7.91	1.47	2.34	11.72	11.00	9.38	9.00	Trace.	....	......	26.97	35.00	1110
1111	" " Potato Fert.	......	0.15	2.26	2.41	2.05	7.30	1.30	2.23	10.83	11.00	8.60	9.00	2.86	3.00	2.52	28.09	37.00	1111
1112	Crocker's Am. Bone Superphosphate	......	0.08	3.04	3.12	2.87	8.61	1.88	1.34	11.83	9.00	10.49	8.00	1.54	1.00	1.48	32.10	35.00	1112
1122	Bradley's Superphosphate of Lime	......	0.51	2.07	2.58	2.43	8.79	0.87	3.08	12.74	....	9.66	9.00	2.38	2.00	2.19	30.98	38.00	1122
1123	W. F. Allen's Complete Manure	......	......	2.27	2.27	2.43	8.91	0.73	1.80	11.44	12.00	9.64	10.00	2.12	2.00	0.39	29.58	34.00	1123

GROUND BONE

Furnishing Nitrogen and Insoluble Phosphoric Acid.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station number.
816	Pure Ground Bone	J. Y. Dilatush, Newtown, N. J.	John Hyres, Robbinsville, N. J.	816
891	Ground Bone	Peter Cooper Glue Co., New York.	J. M. White, New Brunswick.	891
905	Ground Bone	Mapes F. and P. Guano Co., New York.	J. S. Grover, Red Bank.	905
930	Bone Meal	A. W. South, Philadelphia, Pa.	Theo. F. Baker, Bridgeton.	930
934	Button Bone	L. Moritz, " "	" " "	934
946	Pure Bone Meal	Sharpless & Carpenter, Philadelphia, Pa.	" " "	946
997	Swift-Sure Ground Bone	M. L. Shoemaker & Co., " "	H. I. Budd, Mount Holly.	997
998	" " Bone Meal	" " " " "	" " "	998
1027	Strictly Pure Raw Bone Meal	Baugh & Sons, " "	" " "	1027
1047	Bone Meal	" " " "	L. Mortimer, Vineland.	1047
1064	Pure Ground Bone	J. E. Tygert & Co., " "	H. I. Budd, Mount Holly.	1064
1089	Crescent Bone	Lister Bros., Newark.	J. M. White, New Brunswick.	1089
1091	Celebrated Ground Bone	" " "	" " "	1091

GROUND BONE

Furnishing Nitrogen and Insoluble Phosphoric Acid.

Station number.	MANUFACTURER.	Mechanical Analysis.					Chemical Analysis.		Value of 2,000 pounds at Station Prices.	Selling Price of 2,000 pounds.	Station number.
		Finer than 1/50 inch.	Finer than 1/25 inch.	Finer than 1/12 inch.	Finer than 1/8 inch.	Coarser than 1/8 inch.	Nitrogen.	Phosphoric Acid.			
816	J. Y. Dilatush	39	48	13	....	....	3.63	22.78	$37.65	$31.00	816
891	Peter Cooper Glue Co.	35	20	18	27	....	1.32	31.77	37.81	25.00	891
905	Mapes' F. and P. Guano Co.	20	32	20	28	....	2.23	28.42	36.30	35.00	905
930	A. W. South	31	37.5	19.5	10	2	3.44	20.45	33.04	....	930
934	L. Moritz	21	19	26	25	9	3.83	25.14	36.51	32.00	934
946	Sharpless & Carpenter	45	51	4	....	....	3.79	23.40	39.46	34.00	946
997	M. L. Shoemaker & Co.	45	34	13	7	1	5.81	22.48	44.01	36.00	997
998	" " "	56	38	6	....	....	6.09	21.86	45.85	37.00	998
1027	Baugh & Sons	49	45	6	....	....	3.73	23.35	39.27	30.00	1027
1047	" "	48	43	9	....	....	3.58	22.17	37.28	30.00	1047
1064	J. E. Tygert & Co	54	30	13	....	3	2.42	23.04	34.13	33.00	1064
1089	Lister Bros.	24	25.5	22.5	21	7	3.94	13.77	25.93	24.00	1089
1091	" "	24.5	25.5	20	23	7	3.73	14.49	26.03	25.00	1091

DISSOLVED BONES AND NITROGENOUS SUPERPHOSPHATES

Furnishing Nitrogen and Available Phosphoric Acid.

Station No.	BRAND.	MANUFACTURER.	SAMPLED BY	Station No.
907	Universal Dissolved Bone	Williams, Clark & Co., New York.	J. S. Grover, Red Bank.	907
996	Ammoniated Dissolved Bone	M. L. Shoemaker & Co., Philadelphia.	H. I. Budd, Mt. Holly.	996
1003	Swift Sure Dissolved Bone	" " " "	" " "	1003
1030	$25 Phosphate	Baugh & Sons, Philadelphia.	" " "	1030
1031	Raw Bone Superphosphate	" " "	" " "	1031
1033	Strictly Pure Dissolved Raw Bones	" " "	" " "	1033
1062	Dissolved Bone	J. E. Tygert & Co., "	" " "	1062
1080	Dissolved Bone	B. F. Ruckman, Adams' Station (P. R. R.), N. J.	John V. D. Oliver, New Brunswick.	1080

Analyses and Valuations.

Station number.	BRAND.	Nitrogen.		Phosphoric Acid.							Estimated Value of 2,000 lbs. at Station Prices.	Selling Price of 2,000 pounds at Factory.	Station number.
									Available.				
		Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Found.	Guaranteed.			
907	Williams, Clark & Co., Universal Dissolved Bone	2.08	1.64	6.53	1.75	2.24	10.52	10.00	8.28	9.00	$23.83	$34.00	907
996	Shoemaker's Ammoniated Dissolved Bone	1.30	0.82	4.45	8.70	6.95	15.10	11.00	8.15	8.00	24.17	28.00	996
1003	" Swift Sure Dissolved Bone	2.77	1.64	9.56	2.88	6.96	19.40	13.00	12.44	10.00	37.36	36.00	1003
1030	Baugh & Sons' $25 Phosphate	1.78	1.64	3.92	2.50	3.79	10.21	8.20	6.42	5.00	20.50	25.00	1030
1031	" " Raw Bone Superphosphate	2.39	2.05	6.72	1.72	3.98	12.42	…………	8.44	9.00	26.38	32.00	1031
1033	" " Strictly Pure Dissolved Raw Bones	2.54	1.64	2.80	9.71	3.98	16.49	…………	12.51	8.00	32.90	31.00	1033
1062	Tygert & Co.'s Dissolved Bone	3.64	1.64	4.68	2.25	2.44	9.37	14.00	6.93	12.00	27.07	32.00	1062
1080	Ruckman's Dissolved Bone	4.18	2.50	5.41	3.72	2.29	11.42	14.00	9.13	…………	32.57	35.00	1080

SOLUBLE BONE AND POTASH

Furnishing Available Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY	Station number.
963	Soluble Bone, with Potash	J. C. Gaskill, Birmingham.	H. I. Budd, Mount Holly.	963
1035	" " and "	N. J. Chemical Co., Camden, N. J.	" " " "	1035
1081	Ashley Ash Element	Ashley Phosphate Co., Charleston, S. C.	E. Williams, Montclair, N. J.	1081

Analyses and Valuations.

Station number.	BRAND.	Phosphoric Acid.							Potash.		Chlorine.	Estimated Value 2,000 Pounds.	Selling Price 2,000 Pounds.	Station number.
		Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.				
							Found.	Guaranteed.						
963	Gaskill's Soluble Bone, with Potash	13.06	1.21	2.83	17.10	12.00	14.27	10.00	0.48	2.00	0.14	$28.29	$25.00	963
1035	N. J. Chemical Co.'s Soluble Bone and Potash	8.06	1.84	3.92	13.82	....	9.90	12.00	5.10	2.50	4.80	24.92	25.00	1035
1081	Ashley Ash Element	1.04	1.89	3.75	6.68	9.00	2.93	4.50	6.19	3.78	16.20	13.15	15.00	1081

No. 1,079, ORCHILLA GUANO. R. A. Wooldridge & Co., Baltimore, Md., importers. Sampled by A. P. Arnold, Vineland, N. J.

Guaranteed analysis: Total phosphoric acid, 14 per cent.; ammonia, trace; potash, one-third of 1 per cent. Contains 6.06 per cent. phosphoric acid, soluble in ammonium citrate at 40° C.; 11.35 per cent. insoluble in ammonium citrate at 40° C.; 17.41 per cent. total phosphoric acid; 0.06 per cent. nitrogen and 0.15 per cent. potash. Valuation at Station prices, $19.13 per ton. Selling price, $23.

No. 1,124, ORCHILLA GUANO. R. A. Wooldridge & Co., Baltimore, Md., importers. Sampled by Samuel R. Lippincott, Moorestown, N. J.

Guaranteed analysis: Total phosphoric acid, 17.91 per cent. Contains 7.07 per cent. phosphoric acid, soluble in ammonium citrate at 40° C.; 11.00 per cent. insoluble in ammonium citrate at 40° C.; 18.07 per cent. total phosphoric acid. Valuation at Station prices, $20.11 per ton. Selling price, $23.

No. 910, FISH GUANO. H. Preston & Sons, Greenpoint, L. I. Sampled by J. S. Grover, Red Bank, N. J.

Guaranteed analysis: Nitrogen, 3.50 per cent.; total phosphoric acid, 5 per cent. Contains 2.65 per cent. soluble; 2.07 per cent. reverted, and 1.24 per cent. insoluble phosphoric acid; 1.02 per cent. nitrogen as ammonia salts, and 3.00 per cent. as organic nitrogen. Valuation at Station prices, $24.04. Selling price, per ton, $30.

No. 1,107, DRIED FISH. Daniel Vail, Port Monmouth, N. J. Sampled by John W. Roberts, New Monmouth, N. J. Contains 6.58 per cent. phosphoric acid and 7.65 per cent. nitrogen. Valuation at Station prices, $23.20. Selling price, per ton, $25.

No. 901, CANADA UNLEACHED ASHES. Monroe, Judson & Stroup, Oswego, N. Y. Sampled by J. S. Grover, Red Bank, N. J.

Guaranteed composition: 4.50 per cent. actual potash. Contains 1.87 per cent. phosphoric acid; 6.25 per cent. potash; 37.24 per cent. lime. Valuation at Station prices, $13.78. Selling price, $15 per ton.

II.

AGRICULTURAL RELATIONS.

The expression "agricultural relations of fertilizers" is intended to include only the study of the gains or losses resulting from their use.

The losses which consumers may suffer, either by the payment of extortionate prices or by the failure to obtain the amount and kind of plant food which they may purchase, have been discussed upon the preceding pages.

The present chapter is devoted to the far more serious losses which result either from the failure to use fertilizers or from their wasteful and improper use.

In the Station's present conditions, *field trials* offer the only available method for studying such losses.

The work of carrying out similar trials has been steadily progressing during the past ten years, the system first introduced into this country by Professor W. O. Atwater having come into general use. During the past five years this system has been employed by this Station with the following ends in view:

1. To awaken among farmers a desire for accurate investigation.
2. To familiarize farmers with the general appearance of materials which furnish nitrogen, phosphoric acid and potash.
3. To show the effects of these elements when used either alone or in combination upon different crops grown on widely differing soils.
4. To train a body of men for studying the complicated questions involved in the rational and profitable use of fertilizers.

The past season's work includes ten soil tests, in which the crops raised were corn, wheat, rye, oats, buckwheat and clover.

In addition nine experiments were made upon corn and one upon turnips. In these trials the aim was to test the effects of the *four* different forms of phosphoric acid now recognized by many agricultural chemists.

One experiment was successfully closed in which the effects upon wheat of the nitrogen from *wool waste* was studied and compared with the effects of the nitrogen from ammonium sulphate, and two experiments are reported on the effects of fertilizers upon sugar production in sorghum.

Fifteen different farms in widely different sections of the State were tested by these trials; details are given in full upon subsequent pages.

FIELD EXPERIMENTS WITH FERTILIZERS ON CORN.

BY THEODORE WEST, COLLEGE FARM, NEW BRUNSWICK, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.		
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Ears.	Bushels of Shelled Corn.	Pounds of Stalks.
1	Nothing			5,250	65.6	4,635
2	Nitrate of Soda	150 lbs.	$4 05	5,625	70.3	4,500
3	Superphosphate	350 lbs.	3 67	5,750	71.9	4,750
4	Muriate of Potash	150 lbs.	3 00	5,437	68.0	5,312
5	Nitrate of Soda Superphosphate	150 350 } lbs.	7 72	6,125	76.6	4,750
6	Nothing			5,312	66.4	4,375
7	Nitrate of Soda Muriate of Potash	150 150 } lbs.	7 00	5,812	72.6	5,812
8	Superphosphate Muriate of Potash	350 150 } lbs.	6 67	5,937	74.2	5,437
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 } lbs. 150	10 72	5,937	74.2	5,437
10	Plaster	400 lbs.	1 50	4,937	61.7	4,635
11	Fine Barnyard Manure	20 2-horse loads.	30 00	6,687	83.6	6,250

This is the first experiment in the rotation. The corn was planted in drills three feet six inches apart by a corn planter and cultivated in the usual manner.

The season was considered favorable.

The yield from unmanured plots indicates a high state of cultivation, and though all ingredients except plaster increased the yield, the increase was without financial profit.

These results confirm previous experience with corn on that farm.

In regard to the yield of stalks the increase is relatively greater wherever potash is used.

On plot six, the ratio of corn to stalks is one bushel to sixty-six pounds; with nitrate of soda the ratio is one bushel to sixty-four pounds; with superphosphate it is one bushel to sixty-six pounds. The muriate of potash changes the ratio to one bushel of corn to seventy-eight pounds of stalks, and barnyard manure one bushel to seventy-five pounds.

This effect of the muriate has been previously noted and should not be underestimated, now that stalks are regarded as of considerable value in furnishing large quantities of an important element of stock food.

FIELD EXPERIMENTS WITH FERTILIZERS ON CORN.

BY J. M. DALRYMPLE, HOPEWELL, MERCER COUNTY, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.				
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Ears Good.	Pounds of Ears Poor.	Bushels of Shelled Corn Good.	Bushels of Shelled Corn Poor.	Pounds of Stalks.
1	Nothing	....	....	1,250	1,150	15.6	14.3	5,750
2	Nitrate of Soda..........	150 lbs.	$4 05	1,950	1,000	24.4	12.5	3,850
3	Superphosphate.........	350 lbs.	3 67	4,200	710	52.5	8.9	5,100
4	Muriate of Potash......	150 lbs.	3 00	3,000	1,130	37.5	14.1	4,950
5	Nitrate of Soda......... Superphosphate..........	150 350 } lbs.	7 72	2,550	1,180	31.8	14.7	5,660
6	Nothing....................	....	....	1,480	990	18.5	12.4	4,900
7	Nitrate of Soda.......... Muriate of Potash......	150 150 } lbs.	7 00	4,600	950	57.5	11.9	4,850
8	Superphosphate......... Muriate of Potash......	350 150 } lbs.	6 67	3,750	980	46.9	12.2	5,600
9	Nitrate of Soda......... Superphosphate........ Muriate of Potash......	150 350 150 } lbs.	10 72	3,250	1,060	40.6	13.2	5,280
10	Plaster......................	400 lbs.	1 50	1,550	1,060	19.4	13.2	4,650
11	Fine Barnyard Manure	20 2-horse loads......	30 00	4,200	820	52.5	10.2	5,300

This is the first experiment in the rotation, though a similar trial upon corn was carried out upon a different part of this farm last year. A wheat crop was harvested in 1884, but the grass was a failure, and when plowed for corn in 1885 the field looked like a barren tract.

Two-thirds of the fertilizers were sown at the time of planting and harrowed in, the remaining third was mixed with earth and applied about the hills. The corn was cultivated level with a spring tooth harrow till near the end of the season, when it was plowed once to the hill. All fertilizing ingredients were effective. The lack of uniformity in the results, however, renders it impossible to draw trustworthy conclusions.

FIELD EXPERIMENTS WITH FERTILIZERS ON OATS.

BY N. S. SERGENT, SCHOOLEY'S MOUNTAIN, HUNTERDON COUNTY, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.			
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Oats.	Bushels of Oats.	Pounds of Straw.	Pounds per Measured Bushel.
1	Nothing			1,400	46.6	1,120	30.5
2	Nitrate of Soda	150 lbs.	$4 05	1,510	50.3	1,370	30.6
3	Superphosphate	350 lbs.	3 67	1,420	47 3	1,150	31.4
4	Muriate of Potash	150 lbs.	3 00	1,620	54.0	1,290	32.0
5	Nitrate of Soda Superphosphate	150 350 lbs.	7 72	2,000	66 6	1,530	32.0
6	Nothing			1,640	54 6	1,260	30 3
7	Nitrate of Soda Muriate of Potash	150 150 lbs.	7 00	1,910	63.6	1,590	31.4
8	Superphosphate Muriate of Potash	350 150 lbs.	6 67	1,900	66.3	1,450	33.0
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 lbs. 150	10 72	2,180	70.6	1,600	33.6
10	Plaster	400 lbs.	1 50	1,780	59 3	1,350	31.3
11	Fine Barnyard Manure	20 2-horse loads	30 00	2,330	77.6	1,840	32.8

This experiment is the second in the series upon this farm.

The increased yields from the use of fertilizers range from five to thirty bushels, yet the increase is profitable only in the case of plaster. The very favorable effect of this compound was also noticed upon corn in 1884.

The increase from the use of superphosphates which contain fifty per cent. of plaster is especially noticeable upon plots five and eight.

The results also corroborate the statement made in regard to this fact in Mr. Sergent's experiment of 1884—the power of plaster to decompose certain compounds rich in potash—since there is a corresponding relation between the yields from the use of potash and plaster.

FIELD EXPERIMENTS WITH FERTILIZERS ON WHEAT.

BY JOHN VOORHEES, SOUTH BRANCH, SOMERSET COUNTY, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.		
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Wheat.	Bushels of Wheat.	Pounds of Straw.
1	Nothing			115	1.9	415
2	Nitrate of Soda	150 lbs.	$4 05	105	1.7	265
3	Superphosphate	350 lbs.	3 67	390	6.5	690
4	Muriate of Potash	150 lbs.	3 00	320	5.3	710
5	Nitrate of Soda Superphosphate	150 350 lbs.	7 72	775	12.9	1,105
6	Nothing			130	2.2	330
7	Nitrate of Soda Muriate of Potash	150 150 lbs.	7 00	180	3.0	710
8	Superphosphate Muriate of Potash	350 150 lbs.	6 67	660	11 0	1,260
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 lbs. 150	10 72	650	10.8	1,155
10	Plaster	400 lbs.	1 50	180	3.0	400
11	Fine Barnyard Manure	20 2-horse loads	30 00	995	16.6	1,535

This experiment is the third in rotation on this farm. The plots were parallel to each other and faced the west, a fence running north and south forming their eastern boundary.

Early in the winter an easterly snowstorm formed a heavy drift along this fence and protected the wheat upon approximately thirty feet of each plot.

The grain and grass upon the rest of each plot were unprotected, and to a great extent perished; thus, in nearly every case the weight of the product was secured from the protected portion.

Taking this fact into consideration, the effect of certain fertilizers was marked.

Superphosphate and muriate of potash increase the percentage yield very largely. No effect is produced by nitrate of soda when used alone, though in combination with superphosphate the highest yield from mixed fertilizers is secured.

The very high percentage increase on Plot 11 is perhaps largely due to the protecting influence of the organic matter in the barnyard manure.

These results, though impaired by the circumstances mentioned, indicate very plainly that protection in winter is a very valuable adjunct to even large quantities of plant food.

FIELD EXPERIMENTS WITH FERTILIZERS ON WHEAT.

BY THEODORE WEST, COLLEGE FARM, NEW BRUNSWICK, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE			Net Gain or Loss.
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Wheat.	Bushels of Wheat.	Pounds of Straw.	
1	Nothing	....	....	1,090	18.1	960	....
2	Nitrate of Soda.........	150 lbs.	$4 05	1,100	18.3	1,100	+$5 37
3	Superphosphate.........	350 lbs.	3 67	1,090	18.2	1,110	+5 69
4	Muriate of Potash......	150 lbs.	3 00	800	13.4	800	+0 47
5	Nitrate of Soda....... Superphosphate.........	150 350 lbs.	7 72	1,240	20.7	1,490	+5 47
6	Nothing	....	....	650	10.8	550	....
7	Nitrate of Soda......... Muriate of Potash	150 150 lbs.	7 00	880	14.6	920	−1 91
8	Superphosphate......... Muriate of Potash.......	350 150 lbs.	6 67	1,090	18.2	960	+2 16
9	Nitrate of Soda .... Superphosphate......... Muriate of Potash.......	150 350 150 lbs.	10 72	1,310	23.0	1,240	+3 89
10	Plaster	400 lbs.	1 50	450	7.7	500	−4 68
11	Fine Barnyard Manure	20 2-horse loads.	30 00	1,330	22.2	1,720	−14 53

This is the third experiment in the rotation. From the position of the plots, No. 6 is thought to represent the condition of the unmanured land better than No. 1.

Nitrate of soda and superphosphate are the ruling elements, whether used alone or in combination with each other; a financial profit following their use in every case.

Muriate of potash produced a slight increase in yield when used alone; in combination with nitrate of soda, however, its effect seems to have been injurious.

A financial loss follows the use of plaster and barnyard manure.

FIELD EXPERIMENTS WITH FERTILIZERS ON WHEAT.

BY SAMUEL P. RIDGEWAY, HURFFVILLE, GLOUCESTER COUNTY, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.		
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Wheat.	Bushels of Wheat.	Pounds of Straw.
1	Nothing			1,100	18.3	1,230
2	Nitrate of Soda	150 lbs.	$4 05	1,280	21.3	1,710
3	Superphosphate	350 lbs.	3 67	1,200	20.0	1,055
4	Muriate of Potash	150 lbs.	3 00	800	13.3	1,180
5	Nitrate of Soda Superphosphate	150 350 lbs.	7 72	1,350	22.5	1,015
6	Nothing			930	15.5	1,470
7	Nitrate of Soda Muriate of Potash	150 150 lbs.	7 00	1,470	24.5	1,060
8	Superphosphate Muriate of Potash	350 150 lbs.	6 67	1,110	18.5	1,640
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 lbs. 150	10 72	1,500	25.0	1,590
10	Plaster	400 lbs.	1 50	735	12.3	880
11	Fine Barnyard Manure	20 2-horse loads.	30 00	1,100	18.3	1,425

This is the second experiment in the rotation on this farm.

Mr. Ridgeway reports the average yield of wheat to be about fifteen bushels per acre.

The past season was not considered favorable, as at seeding time it was very dry and the winter was cold and windy, with little snow for protection; the spring was also cold and backward. The results, when harvested, correspond with differences in plots observed April 18th. All fertilizer ingredients seem to have exerted a favorable influence, though not in any case sufficient to cause a financial profit.

FIELD EXPERIMENTS WITH FERTILIZERS ON RYE.

BY THEODORE WEST, COLLEGE FARM, NEW BRUNSWICK, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.			Net Gain or Loss.
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Rye.	Bushels of Rye.	Pounds of Straw.	
1	Nothing			830	14.8	1,070	
2	Nitrate of Soda	150 lbs.	$4 05	720	12.8	1,030	—$6 75
3	Superphosphate	350 lbs.	3 67	1,300	23.2	2,150	+11 06
4	Muriate of Potash	150 lbs.	3 00	790	14.1	1,110	—4 13
5	Nitrate of Soda Superphosphate	150 350 lbs.	7 72	1,400	25.0	2,500	+11 59
6	Nothing			840	15.0	1,280	
7	Nitrate of Soda Muriate of Potash	150 150 lbs.	7 00	1,040	18.6	1,100	—5 53
8	Superphosphate Muriate of Potash	350 150 lbs.	6 67	1,280	22.7	2,270	+8 96
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 lbs. 150	10 72	1,650	29.5	2,900	+15 29
10	Plaster	400 lbs.	1 50	1,000	17.8	1,400	+2 49
11	Fine Barnyard Manure	20 2-horse loads	30 00	2,100	37.5	3,900	+10 81

This is the second experiment in the rotation, rye being sown after corn in 1884.

EFFECT OF FERTILIZERS.

Nitrate of soda and muriate of potash were of no effect when used alone; in combination with each other the yield of grain was increased by 3.6 bushels, but the yield of straw was decreased by 160 pounds.

Superphosphate produced a very favorable effect upon the yield of both grain and straw. This effect is apparent whether the superphosphate is used alone or in combination with other ingredients.

The largest increase in yield was secured from barn-yard manure, the proportion of straw to grain being also relatively greater upon this plot.

Plaster increased the yield of grain 2.8 bushels and of straw 140 pounds.

PROFIT AND LOSS.

Though a loss was entailed by the use of nitrate of soda and muriate of potash, both alone and in combination with each other, the highest profit, $15.29, was secured from the complete fertilizer on Plot 9.

Superphosphate was profitable wherever used.

The very large increase in yield from barn-yard manure gave a net profit of $10.81.

Plaster was also slightly profitable.

GENERAL REMARKS.

The exact extent to which the dressing of barn-yard manure, applied in the spring of 1884, should modify the calculation of profits from Plot 11, cannot be determined.

The results indicate, however, that both barn-yard manure and superphosphate alone, and in combination as a complete manure, may be used with profit on rye.

A comparison of the crop values of rye and wheat calculated from the yields of these experiment plots, shows rye to be the more profitable.

This is entirely due to the greater market value of the rye straw, which, for a short time during the past year, was reported to be worth $25 per ton. The average yield of wheat from the unmanured land was about eleven bushels, by the use of fertilizers over twenty-three bushels were harvested. The average yield of rye was fifteen bushels, which was increased to 37.5 bushels by the use of fertilizers. At present prices the value of the wheat per acre is greater than that of the rye.

Many farmers object to sowing rye since it is seldom that a good grass crop follows. The reasons for this are, either that the land good enough to raise a fair rye crop is too poor to raise grass, or that the rye starting earlier and being of heavier growth chokes and kills the grass.

FIELD EXPERIMENTS WITH FERTILIZERS ON BUCKWHEAT.

BY STEPHEN C. DAYTON, BASKING RIDGE, SOMERSET COUNTY, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.			Weight per Measured Bushel.
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Grain.	Bushels of Grain.	Pounds of Straw.	
1	Nothing			390	7.8	620	43
2	Nitrate of Soda	150	$4 05	465	9.3	705	43
3	Superphosphate	350	3 67	1,340	26 8	2,690	46
4	Muriate of Potash	150	3 00	475	9.5	755	43
5	Nitrate of Soda Superphosphate	150 350 } 500	7 72	1,430	28.6	2,750	45.5
6	Nothing			480	9 6	700	43
7	Nitrate of Soda Muriate of Potash	150 150 } 300	7 00	385	7.7	565	42
8	Superphosphate Muriate of Potash	350 150 } 500	6 67	1,530	30.6	3,050	43
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 } 650 150	10 72	1,500	30.0	3,230	43
10	Plaster	400	1 50	570	11.4	1,000	45
11	Fine Barnyard Manure	20 two-horse loads.	30 00	1,230	24 6	2,950	45
12	Barnyard Manure Lime	1 load 5 bushels		1,090	21.8	2,410	46

This is the second experiment in the series, the primary object of which is to study the effect of different fertilizers upon peach trees. The trees were planted April 24th, 1884; each plot of one-tenth acre containing thirteen. About 335 square feet of surface is therefore allowed for each tree.

In this, the second year of their growth, no noticeable difference in size can be seen. A much better color, however, is noted on plots 3, 5, 8, 9, 11 and 12, where superphosphate and barnyard manure were used.

Mr. Dayton has previously studied the effect of fertilizers upon corn, oats and clover upon another section of his farm, and the result this year upon buckwheat verifies the statement made in the Report of 1884—that superphosphates used alone, irrespective of crop or season, have invariably increased the yield.

Superphosphates were effective in every case, when used upon the experimental corn grown last year among the trees upon these plots, and this season superphosphates upon buckwheat yield the largest profit. No increase in yield was produced by nitrogen or potash when used either alone or in combination with each other, and when used in combination with superphosphate the increased yield has been proportional to the increase secured from the superphosphate alone.

The yield from the barnyard manure plot is not as great in proportion as that produced by this fertilizer upon other crops. This is doubtless due to the fact that in the short time necessary to grow buckwheat, from July 19th to October 2d, a small quantity only of plant food is rendered available. Half the quantity of barnyard manure, in connection with fifty bushels of lime per acre, produced 21.8 bushels, showing an increase of only 2.8 bushels from the extra ten loads of manure used without lime.

FIELD EXPERIMENTS WITH FERTILIZERS ON CLOVER.

BY REV. HENRY P. THOMPSON, READINGTON, HUNTERDON CO., N. J.

Number of Plot.	FERTILIZERS.		Cost per Acre.	Pounds per Acre.
	Kind.	Weight per Acre.		
1	Nothing	....	....	1,400
2	Nitrate of Soda	150 lbs.	$4 05	1,730
3	Superphosphate	350 lbs.	3 67	1,250
4	Muriate of Potash	150 lbs.	3 00	1,000
5	Nitrate of Soda Superphosphate	150 350 } lbs.	7 72	1,750
6	Nothing	....	....	1,060
7	Nitrate of Soda Muriate of Potash	150 150 } lbs.	7 00	1,070
8	Superphosphate Muriate of Potash	350 150 } lbs.	6 67	1,250
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 } lbs. 150	10 72	1,730
10	Plaster	400 lbs.	1 50	1,450
11	Fine Barnyard Manure	20 2-horse loads	30 00	3,660

This experiment completes the usual four-year rotation on this farm. The variation in yields from the different plots is not marked. The only one showing a reasonable return is No. 11. Mr. Thompson's carefully-kept notes explain this result. Observations taken by him September 12th, 1884, show plots 1, 2, 6 and 10 to be very poor and weedy; plots 3, 4, 5 and 8, well seeded with clover and timothy; 9 and 11, well seeded in timothy alone; No. 8, the best clover.

The fertilizers were applied September 22d, 1884, weather very dry. The months of February and March, 1885, were very cold and dry; the whole number of plots were not protected by snow at any time. The spring was cold and backward. Observations taken April 13th showed plots 1, 4, 6, 7 and 10 very bare; No. 11 the best, with Nos. 9 and 8 next in order. Again, May 7th, no clover except on No. 8; plot 11 good, but entirely timothy. This record shows that all the plots except No. 8, containing clover in the fall, were bare in the spring, leaving practically nothing for the fertilizers to feed. Plot 11 was entirely timothy, and was doubtless largely protected by the barnyard manure.

FIELD EXPERIMENTS WITH FERTILIZERS ON CLOVER.

BY A. P. ARNOLD, VINELAND, CUMBERLAND CO., N. J.

	FERTILIZERS.			YIELD PER ACRE		
Number of Plot.	Kind.	Weight per Acre.	Cost per Acre.	Pounds—First Cut.	Pounds—Second Cut.	Total Weight.
1	Nothing	....	....	440	210	650
2	Nitrate of Soda	150 lbs.	$4 05	450	210	660
3	Superphosphate	350 lbs.	3 67	680	420	1,100
4	Muriate of Potash	150 lbs.	3 00	810	430	1,240
5	Nitrate of Soda Superphosphate	150 350 lbs.	7 72	1,070	440	1,510
6	Nothing	....	....	460	120	580
7	Nitrate of Soda Muriate of Potash	150 150 lbs.	7 00	760	330	1,090
8	Superphosphate Muriate of Potash	350 150 lbs.	6 67	1,530	620	2,150
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 lbs. 150	10 72	1,680	740	2,420
10	Plaster	400 lbs.	1 50	390	390	780
11	Fine Barnyard Manure.	20 2-horse loads	30 00	3,160	2,360	5,520
A	Canada Ashes	100 bu.	36 00	1,380	1,360	2,740
B	Home Ashes	100 bu.	....	1,240	940	2,180
C	Dissolved S. C. Rock	1,000 lbs.	10 00	2,120	740	2,860
D	Orchilla Guano	1,000 lbs.	12 50	2,110	590	2,700

This experiment is the fourth in rotation, carried out on this farm under the Station's direction.

The four plots indicated above by letters were laid out parallel with the others, and were planned by Mr. Arnold for the purpose of studying the effect of different forms of phosphoric acid when applied in large quantities.

The soil is very sandy, with sandy subsoil mixed with clay and gravel.

Mr. Arnold's previous experiments with fertilizers have indicated an insufficiency of all the elements of plant food.

In this experiment, the first cut of clover was harvested June 16th, 1885. Owing to the very dry weather of June and July, the second crop did not start until the heavy rains of August; it was harvested September 23d, 1885.

The highest yield was produced by the barn-yard manure. The increase is particularly noticeable in the second cut; in this connection it must be remembered that the large quantity of fertilizing material applied in barn-yard manure had been accumulating for four years, and also that the organic matter which it contained doubtless exerted a favorable influence in retaining moisture.

The yield was nearly doubled by both potash and phosphoric acid, when used alone; when used in combination with each other and with nitrogen, the proportionate rate of increase was held.

Nitrate nitrogen used alone was of no effect. Other experiments by Mr. Arnold show that good crops can be secured from the use of large quantities of phosphoric acid in any form, but for profit and almost certain results, Mr. Arnold has found nothing to equal a good acid phosphate for use in raising clover, and upon this largely depends the corn and other crops grown in rotation. In many cases in that section a clover sod makes the crop.

FIELD TRIALS UPON INDIAN CORN, TURNIPS, WHEAT AND RYE.

MADE TO TEST AND COMPARE

Various Forms of Available Phosphoric Acid.

As stated in a preceding section of this Report, agricultural chemists in the United States have recognized for many years past three distinct classes of phosphates:

First—Those which dissolve in water.

Second—Those which dissolve in neutral solutions of citrate of ammonia at temperatures not exceeding 100° Fahr.

Third—Those which are insoluble in both of the above-named fluids.

The phosphates included in the first and second classes are known to be of agricultural value whenever they are properly used upon suitable soils. Regarding those in the third class, however, it has been assumed until recently that their agricultural value was too low to be worthy of notice.

Three years ago, at a convention held in Atlanta, Ga., a large number of chemists from different States created a fourth class, by isolating from the third all phosphates which dissolve in neutral solutions of citrate of ammonia at temperatures ranging between 100° and 150° Fahr. By adopting this test it was tacitly understood that phosphates which respond to it should rank with those in the first and second classes.

In 1884, Dr. Charles U. Shepard published a very interesting paper containing analyses, which indicate that a fifth class may some day be formed, to include all phosphates which dissolve in neutral solutions of citrate of ammonia at temperatures ranging between 150° and 195° Fahr.; in fact, one or more manufacturers have already published guarantees, claiming that all phosphates are available which dissolve in citrate solutions at temperatures not exceeding their boiling points under ordinary atmospheric pressures.

It becomes, therefore, a matter of importance to decide whether citrate of ammonia, *at any given temperature*, is a reliable agent for distinguishing between agriculturally valuable and agriculturally worthless phosphates. At present this reagent is often regarded simply as a chemical convenience, agriculturally reliable only under certain indistinctly recognized conditions.

The following case is cited as an illustration of the far-reaching effects caused by the adoption of a chemical method.

With the intention of benefiting farmers, German Experiment Stations for many years have positively declined to recognize phosphates which are insoluble in distilled water. This rule renders it unprofitable for manufacturers to use domestic mineral phosphates as crude stock, for superphosphates made from such supplies undergo changes while in storehouses which rapidly diminish their percentages of soluble phosphoric acid.

Superphosphates made from foreign guanos may be stored for months without undergoing such changes; consequently German merchants eagerly search all sections of the globe for guanos, while German mineral deposits remain undeveloped. This condition of affairs is due entirely to the *opinion* that for farmers' use only those phosphates are valuable which readily dissolve in distilled water.

For certain soils, however, there are other combinations of phosphoric acid which appear to be more valuable than those which dissolve in water only. As far as known, phosphates which are soluble in citrate of ammonia at a temperature not exceeding 100° Fahr., may be included in this class. Direct experiments upon plants, carried out both in this country and in Europe, support this opinion.

The conclusions from these experiments have been accepted in this country, and although superphosphates made from South Carolina Rock often contain several per cent. of "reverted" phosphoric acid, they still find ready sale at fair rates. The large supplies placed upon the market have caused a steady decline in the prices of all phosphates, and consequently this kind of plant food now stands within the reach of nearly every farmer. It may be that these superphosphates have been used in many cases upon farms where boneblack superphosphates would have been more profitable, but it is equally true that there are soils in this State upon which phosphates which dissolve in citrate of ammonia at 100° Fahr. may be used with more profit than those which dissolve in water. From this standpoint the study should be to determine the conditions which make either soluble or reverted phosphoric acid valuable for farm use.

The Atlanta Convention, mentioned above, by adopting a certain chemical method, recognized iron and alumina phosphates, which, up to that time, had been either ignored or regarded as worthless. The interest of both consumers and producers demands that this method shall be rigorously examined by agricultural trials of all phosphates enrolled by it in the class "available."

If it proves to be a reliable guide, the sooner it is universally followed the better for the country at large, for new deposits will be developed, less expensive methods than the present will be introduced for preparing the raw phosphate for the market, and consequently still further reductions in retail prices of phosphoric acid will follow.

If, however, the results indicate that phosphates of questionable agricultural worth are improperly valued by this test, modifications can be introduced; consumers will thereby be protected from losses, and State chemists will be relieved of one source of anxiety and criticism.

No work belonging to Agricultural Experiment Stations at present appears of greater general importance than that of clearly determining conditions which govern the profitable use of plant food; one very necessary point involved in this study being the introduction of such modifications of chemical tests as are necessary to make them still more reliable guides in the purchase and use of fertilizers.

FIELD EXPERIMENTS.

The field trials published upon the following pages belong to a series which has been planned by this Station to test the effects of *phosphoral* upon plant growth.

Phosphoral is a fertilizer, containing neither nitrogen nor potash. It is made from iron and alumina phosphates by the action of sulphur and heat; the use of sulphuric acid or oil of vitriol being entirely avoided in its preparation.

The Tropic Guano Company, of New York City, donated nearly fifteen hundred pounds of this product to be used by this Station in field trials upon corn, turnips, wheat and rye.

Its analysis, as copied from page 31 of this Report, is as follows:

Phosphoric Acid. Total. Per cent.	Phosphoric Acid. Soluble in water. Per cent.	Phosphoric Acid. Soluble in citrate of ammonia at 100° Fahr. Per cent.	Phosphoric Acid. Soluble in citrate of ammonia at 150° Fahr. Per cent.
49.40	......	4.61	32.65

With less than five per cent. of phosphoric acid soluble at 100° Fahr., and with nearly thirty-three per cent. soluble at 150° Fahr. phosphoral furnishes a striking illustration of a phosphate stamped "worthless" by one test and "valuable" by a second; the difference between the tests lying solely in the temperature employed.

As already stated, the leading object of these experiments is to test the agricultural value of *phosphoral*. The opportunity was, however, utilized to so plan the work that after a considerable number of results have been secured, conclusions might be drawn as to the reliability of citrate of ammonia as a guide in the purchase and use of fertilizers. Phosphoral, therefore, has been compared with bone-black superphosphate, with precipitated calcium phosphate and with floats. These four materials represent all forms of phosphoric acid which have thus far attracted attention.

Water dissolves practically all of the phosphoric acid in bone-black superphosphate, but it has no solvent action upon the phosphoric acid, either in floats, in phosphoral or in precipitated calcium phosphate. *The bone-black superphosphates therefore represent the first class of phosphates.*

Citrate of ammonia solution, at 100° Fahr., dissolves practically all of the phosphoric acid in precipitated calcium phosphates, and has trifling solvent action only upon the phosphates in phosphoral and in floats. *The precipitated calcium phosphates represent the second class of phosphoric acid.*

Citrate of ammonia solution, at 150° Fahr., dissolves a very large percentage of the total phosphoric acid from phosphoral, and a small percentage only from floats. *Phosphoral, therefore, may be taken as a representative of the class created by the Atlanta Convention*, while floats represent those phosphates which dissolve neither in water nor in citrate of ammonia at recognized temperatures.

Experiments have already demonstrated that soluble phosphoric acid is not always the form from which the highest agricultural results are secured, and cases are not wanting where positive assertions have been made regarding the profits which follow the use of the insoluble phosphoric acid in floats. Enough, therefore, is known to warrant the labor and expense involved in the following trials.

LOCATIONS OF CORN EXPERIMENTS.

In selecting farms upon which to make these trials, especial efforts were directed towards securing typical soils. In five out of nine corn trials, also, the farmers had been prepared for this work by previous experiments under the Station's direction.

Mr. Arnold's farm, near Vineland, Cumberland county, lies upon a sandy loam, characterized as oak land soil; the same description applies to Mr. Macbean's farm, lying three or four miles from Lakewood, in Ocean county. Mr. Benjamin Lippincott's farm, near

Cinnaminson, Burlington county, is upon a tract characterized upon the State geological maps as a sandy clay; the soil upon this farm is a medium loam.

Mr. S. C. Carpenter's farm is in Hunterdon county, near Asbury, on the Warren county line. Limestone crops out in places; the soil is loamy.

The red shale formation is represented by Rev. Henry P. Thompson's farm, near Readington, Hunterdon county; its soil is a clay loam.

The soil upon Mr. S. C. Dayton's farm, near Basking Ridge, Somerset county, is disintegrated trap-rock, characterized as clayey and stony.

Mr. N. S. Sergent's farm lies upon the gneissic formation near Schooley's Mountain, Morris county. It has a good loamy soil.

Mr. Charles Doran's farm, near Barnsboro, Gloucester county, is credited with a sandy loam soil, which, from its position, may consist largely of disintegrated matter from the green sand formation.

Mr. William Vreeland's experiment was made upon soil reclaimed by the drainage of the lowland in the Pequest Valley, near Great Meadow Station, Warren county. It consists of nearly three feet of peat overlying sand; with favorable seasons it produces very large corn crops.

DETAILS OF EXPERIMENTS UPON CORN.

Before the trials were begun, detailed directions were mailed to each experimenter. They indicated the conditions to be observed in order to secure uniformity.

Upon each farm there were fourteen plots, each one-tenth of an acre in area. These plots were parallel and separated from each other by middle furrows.

A headland six feet wide was left at each end of each plot as a turning space; this was done to avoid injury to the plants at the ends of the rows during cultivation.

The corn was planted in drills three feet six inches apart; seven rows, each one hundred and seventy-eight feet long, being laid off upon each plot. It was intended that the stalks should stand about one foot apart in the rows. By planting in drill, cross cultivation was prevented, and those errors were thereby avoided which are caused by drawing plant food from one plot to another.

The fertilizers, mixed either with soil or with moistened saw dust, were sown broadcast and harrowed in. In every case except one, the chemist or the first assistant chemist of the Station was present to witness this work. Mr. George B. Hurff, formerly an assistant chemist, represented the Station at Mr. Charles Doran's farm.

All details, relative either to the kind and quantity of fertilizers used or to the weights of corn and stalks harvested, can be learned from the following tables. One explanation, however, may be necessary: the chemical reaction which occurs when bone-black is treated with oil of vitriol or sulphuric acid, results in the formation of large quantities of plaster; each hundred pounds of the bone-black superphosphate used in these experiments contained nearly fifty pounds of this material, which is not found either in the floats or phosphoral, and is present as traces only in the precipitated calcium phosphate.

The precipitated plaster in bone-black superphosphates doubtless often exerts marked and favorable action upon plant life, consequently it is necessary to add a corresponding quantity of precipitated plaster to floats, phosphoral and precipitated calcium phosphate, whenever a comparison is attempted between the action of the four above-mentioned forms of phosphoric acid.

The precipitated plaster used by this Station was donated in very large quantities by Harrison Brothers, of Philadelphia.

WEATHER.

Three of the experiments (Mr. Dayton's, Mr. Sergent's and Mr. Thompson's) were damaged by a severe storm upon August 3d, and one experiment (Mr. Arnold's) suffered severely from a prolonged drought.

The remaining experiments, judging from the weights of corn and stalks, were not injured by the weather.

The irregularities upon Mr. Vreeland's plots were due to imperfect stands.

The results from each experiment have been tabulated and arranged under three headings.

In the first table, the unmanured plot, No. 1, indicates the crop which the land can produce without the aid of fertilizers; the three following plots were each dressed with phosphoric acid only. As measured by the citrate of ammonia test, however, these three forms of phosphoric acid differ radically from each other; the relative agricultural value of each can be determined by a comparison with plot No. 1.

For reasons above given, it is necessary to mix precipitated plaster with the floats, the phosphoral and the precipitated calcium phosphate, before their effects upon plant growth can be compared with that of bone-black superphosphate; an additional plot, fertilized with plaster alone, is also necessary to make the comparison complete. All these conditions are observed in table No. II.

The best effect of phosphoric acid upon plants can be seen only in the presence of sufficient potash and nitrogen. The comparison was therefore again repeated upon the plots arranged in table III., in each case nitrogen and potash being mixed with the phosphoral, the floats, the precipitated calcium phosphate and the bone-black superphosphate. This table is probably the one from which the most reliable conclusions can be drawn.

FIELD EXPERIMENTS UPON CORN.

TABLE I.

	Number of Plot.	1	3	4	5
	Fertilizers Used per Acre.	No Fertilizer.	Floats, 250 lbs.	Phosphoral, 185 lbs.	Precipitated Phosphate of Lime, 255 lbs.
	Kind and Quantity of Plant-food per Acre.		Phosphoric Acid Insoluble, 60 lbs.	Phosphoric Acid Available at 150°, 60 lbs. Phosphoric Acid Insoluble, 31.4 lbs.	Phosphoric Acid Available at 100°, 60 lbs. Phosphoric Acid Insoluble, 9.4 lbs.
		lbs.	lbs.	lbs.	lbs.
A. P. Arnold	Ears of Corn	1,450	1,460	1,510	1,450
Vineland, Cumberland county	Stalks	2,590	2,570	2,490	2,460
A. S. Macbean	Ears of Corn	800	680	940	1,060
Lakewood, Ocean county	Stalks	3,890	3,580	3,810	4,610
Benjamin Lippincott	Ears of Corn	5,800	5,850	5,150	5,000
Cinnaminson, Burlington county	Stalks	5,900	5,350	5,450	5,550
S. C. Carpenter	Ears of Corn	5,190	5,260	5,250	5,400
Asbury, Hunterdon county	Stalks	3,100	3,130	2,900	2,200
S. C. Dayton	Ears of Corn	4,860	4,310	3,810	4,610
Basking Ridge, Somerset county	Stalks	2,610	2,500	2,130	2,340
N. S. Sergent	Ears of Corn	4,550	4,480	4,580	4,460
Schooley's Mountain, Morris co	Stalks	3,710	4,190	3,590	3,950
Charles Doran	Ears of Corn	4,320	4,360	4,110	3,990
Barnsboro, Gloucester county	Stalks	3,650	4,000	3,800	4,850
Rev. Henry P. Thompson	Ears of Corn	1,510	1,200	1,310	1,970
Readington, Hunterdon county	Stalks	2,140	1,700	1,870	2,240
William Vreeland	Ears of Corn	2,500	4,560	3,700	3,720
Danville, Warren county	Stalks	5,400	7,100	6,000	7,800

FIELD EXPERIMENTS UPON CORN.

TABLE No. II.

Number of Plot.		1	2	6	7	8	9
	Fertilizers Used per Acre.	No Fertilizer.	Precipitated Plaster, 180 lbs.	Bone-Black Superphosphate, 340 lbs.	Precipitated Plaster, 180 lbs. Floats, 250 lbs.	Precipitated Plaster, 180 lbs. Phosphoral, 185 lbs.	Precipitated Plaster, 180 lbs. Precipitated Phosphate of Lime, 255 lbs.
	Kind and Quantity of Plant-food per Acre.		Sulphate of Lime, 164 lbs.	Phosphoric Acid Soluble, 60 lbs. Sulphate of Lime, 163 lbs.	Sulphate of Lime, 164 lbs. Phosphoric Acid Insoluble, 60 lbs.	Sulphate of Lime, 164 lbs. Phosphoric Acid Available at 150°, 60 lbs. Phos. Acid Insoluble, 31.4 lbs.	Sulphate of Lime, 164 lbs. Phosphoric Acid Available at 100°, 60 lbs. Phos. Acid Insoluble, 9.4 lbs.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
A. P. Arnold	Ears of Corn	1,450	1,420	1,840	1,890	1,510	1,560
Vineland, Cumberland county	Stalks	2,590	2,610	2,860	2,220	2,180	2,400
A. S. Macbean	Ears of Corn	800	600	860	1,060	1,050	1,490
Lakewood, Ocean county	Stalks	3,890	3,900	4,200	4,560	4,400	4,900
Benj. Lippincott	Ears of Corn	5,800	5,100	5,100	5,000	5,100	5,250
Cinnaminson, Burlington co	Stalks	5,900	5,450	6,000	5,900	6,050	6,300
S. C. Carpenter	Ears of Corn	5,190	4,740	4,880	5,850	4,080	4,370
Asbury, Hunterdon county	Stalks	3,100	3,000	3,240	2,930	2,920	2,960
S. C. Dayton	Ears of Corn	4,360	3,580	4,500	4,550	3,770	3,460
Basking Ridge, Somerset county	Stalks	2,610	2,810	2,280	2,380	2,000	2,290
N. S. Sergent	Ears of Corn	4,550	4,570	5,200	4,580	4,560	4,570
Schooley's Mountain, Morris co.	Stalks	3,710	3,850	3,880	3,860	3,880	3,960
Charles Doran	Ears of Corn	4,320	3,990	5,060	4,850	4,550	4,420
Barnsboro, Gloucester county	Stalks	3,650	4,000	4,050	4,050	3,850	3,750
Rev. H. P. Thompson	Ears of Corn	1,510	1,220	2,550	2,520	2,480	2,460
Readington, Hunterdon county	Stalks	2,140	1,770	2,680	2,780	2,880	2,870
William Vreeland	Ears of Corn	2,500	3,700	4,200	2,660	2,300	3,600
Danville, Warren county	Stalks	5,400	5,700	6,500	4,600	6,500	6,300

FIELD EXPERIMENTS UPON CORN.

TABLE No. III.

	Number of Plot.	10	11	12	13	14
	Fertilizers Used per Acre.	Precipitated Plaster, 180 lbs. Floats, 250 lbs. Muriate of Potash, 100 lbs. Sulphate of Ammonia, 145 lbs.	Precipitated Plaster, 180 lbs. Phosphoral, 185 lbs. Muriate of Potash, 100 lbs. Sulphate of Ammonia, 145 lbs.	Precipitated Plaster, 180 lbs. Precipitated Phosphate of Lime, 255 lbs. Muriate of Potash, 100 lbs. Sulphate of Ammonia, 145 lbs	Bone-Black Superphosphate, 340 lbs. Muriate of Potash, 100 lbs. Sulphate of Ammonia, 145 lbs.	No Fertilizer.
	Kind and Quantity of Plant-food per Acre.	Sulphate of Lime, 164 lbs. Phosphoric Acid Insoluble, 60 lbs. Potash, 50 lbs. Nitrogen, 60 lbs.	Sulphate of Lime, 164 lbs. Phos. Acid Available at 150°, 60 lbs. Phos. Acid Insoluble, 31.4 lbs. Potash, 50 lbs. Nitrogen, 60 lbs.	Sulphate of Lime, 164 lbs. Phos. Acid Available at 100°, 60 lbs. Phos. Acid Insoluble, 9 4 lbs. Potash, 50 lbs. Nitrogen, 60 lbs.	Sulphate of Lime, 168 lbs. Phos. Acid Soluble, 60 lbs. Potash, 50 lbs. Nitrogen, 60 lbs.	
		lbs.	lbs.	lbs.	lbs.	lbs.
A. P. Arnold	Ears of Corn	1,980	1,880	1,710	1,610	1,620
Vineland, Cumberland co.	Stalks	2,580	2,470	2,420	2,320	1,990
A. S. Macbean	Ears of Corn	2,890	2,580	2,510	2,040	750
Lakewood, Ocean county	Stalks	6,160	5,880	6,260	5,840	3,800
Benjamin Lippincott	Ears of Corn	6,500	6,350	6,200	5,750	4,550
Cinnaminson, Burlington co.	Stalks	8,100	8,000	7,900	7,200	6,000
S. C. Carpenter	Ears of Corn	5,010	6,270	5,710	6,080	4,840
Asbury, Hunterdon county	Stalks	3,100	3,200	3,180	3,250	3,050
S. C. Dayton	Ears of Corn	4,590	4,580	5,580	5,630	4,760
Basking Ridge, Somerset co.	Stalks	2,380	2,510	3,310	3,400	2,600
N. S. Sergent	Ears of Corn	4,890	4,830	4,770	5,370	4,670
Schooley's Mt., Morris co.	Stalks	4,220	4,280	4,290	4,500	3,780
Charles Doran	Ears of Corn	5,520	5,710	5,360	5,130	2,970
Barnsboro, Gloucester co.	Stalks	3,900	4,300	4,000	4,000	3,750
Rev. Henry P. Thompson	Ears of Corn	3,290	3,730	3,600	3,470	3,610
Readington, Hunterdon co	Stalks	3,110	3,230	3,080	2,970	2,610
William Vreeland	Ears of Corn	3,100	2,800	3,360	3,580	3,200
Danville, Warren county	Stalks	5,800	4,500	5,600	7,000	6,800

Calculations have been made from the preceding tables, and tabulated below, to show the gains in yields caused by the fertilizers.

The figures represent the weights of corn by which the crop from the unmanured plot was excelled.

In Mr. Macbean's experiment, for instance, the +140 published for the phosphoral in table A., indicates that the use of this phosphate alone increased the corn crop by one hundred and forty pounds per acre, while table C. indicates that when phosphoral is used in combination with nitrogen and potash, the yield is increased by seventeen hundred and eighty (+1780) pounds per acre.

TABLE A.

Number of Plot.	FERTILIZERS USED.	NAMES OF EXPERIMENTERS.								
		A. P. Arnold.	A. S. Macbean.	B. Lippincott.	S. C. Carpenter.	S. C. Dayton.	N. S. Sergent.	Charles Doran.	H. P. Thompson.	William Vreeland.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
3	Increase of corn caused by Floats	+10	....	....	+70	....	....	+40	....	+2060
4	Increase of corn caused by **Phosphoral**............	+60	**+140**	....	+60	....	**30**	....	....	**+1200**
5	Increase of corn caused by Precipitated Phosphate..........	....	+260	....	+210	+230	....	....	+460	+1220

PHOSPHORAL.

In five cases out of nine phosphoral has caused an increased crop; in two cases out of the five, however, the increase is less than one bushel of shelled corn per acre, while in the remaining three cases the increase, caused either by the floats or by the calcium phosphate, exceeds that caused by phosphoral; consequently, phosphoral used alone in no case can be regarded as preferable to the floats or to precipitated calcium phosphate.

TABLE B.

Number of Plot.	FERTILIZERS USED.	NAMES OF EXPERIMENTERS.								
		A. P. Arnold.	A. S. Macbean.	B. Lippincott.	S. C. Carpenter.	S. C. Dayton.	N. S. Sergent.	Charles Doran.	H. P. Thompson.	William Vreeland.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
2	Precipitated Plaster	....	....	....	....	....	+20	....	....	+1200
6	Bone-Black Superphosphate	....	+60	....	....	+140	+650	+740	+1080	+1700
7	Precipitated Plaster—Floats	....	+260	....	+660	+190	+30	+530	+1010	+160
8	Precipitated Plaster—Phosphoral	+60	+250	....	....	....	+10	+230	+970	....
9	Precipitated Plaster—Precipitated Phosphate of Lime	+110	+690	....	....	....	+20	+100	+950	+1100

Again, in five cases out of nine, phosphoral increases the corn crop; in every case, however, it is surpassed by the yield caused by one of the other forms of phosphoric acid.

TABLE C.

Number of Plot.	FERTILIZERS USED.	NAMES OF EXPERIMENTERS.								
		A. P. Arnold.	A. S. Macbean.	B. Lippincott.	S. C. Carpenter.	S. C. Dayton.	N. S. Sergent.	Charles Doran.	H. P. Thompson.	William Vreeland.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
10	Precipitated Plaster—Floats—Muriate of Potash—Sulphate of Ammonia..................	+410	+2140	+1950	+170	....	+220	+2550	....	....
11	Precipitated Plaster—Phosphoral—Muriate of Potash—Sulphate of Ammonia...........	+360	+1780	+1800	+1430	....	+160	+2740	+120	....
12	Precipitated Plaster—Precipitated Phosphate of Lime—Muriate of Potash—Sulphate of Ammonia.......	+190	+1760	+1650	+870	+820	+100	+2390	....	+160
13	Bone-Black Superphosphate — Muriate of Potash—Sulphate of Ammonia..................	+90	+1290	+1200	+1190	+870	+700	+2160	....	+880

In seven cases out of nine phosphoral causes an increased yield of corn; in three cases, however, it is surpassed by some other form of phosphoric acid, and in two cases the increase is less than two bushels of shelled corn per acre.

In two cases, however—Mr. Charles Doran's and Mr. S. C. Carpenter's—it clearly surpasses all of the other phosphates.

The number of experiments recorded above is not large enough to permit positive conclusions to be drawn. The probabilities, however, are that phosphoral will be a profitable fertilizer when used upon suitable soils.

COMPARISON OF THE SOLUBLE PHOSPHATES WITH THOSE WHICH ARE INSOLUBLE IN WATER.

In eight cases out of nine combinations of soluble phosphoric acid with nitrogen and potash caused increased yields of corn per acre. In five cases out of the eight, however, its yields were surpassed by those from insoluble forms of phosphoric acid, used in all respects under corresponding conditions.

Professor Dunkelberg, of Bonn University, in his very long report to the German Ministry, claims that iron and alumina phosphates are more certain in their action, and altogether preferable to the phosphates soluble in water, whenever they are used either upon sandy or limestone soils, or upon soils containing an excess of shell, marl or peat.

In the Station's experiments upon corn, the soils upon which the insoluble forms of phosphoric acid have shown their superiority are either the oak land of the southern counties, the sandy clay of Burlington or the limestone of Hunterdon. These experiments, therefore, corroborate Dunkelberg's claims, the only exception being found in the case of Mr. Vreeland's peat soil; in this trial the results are not regarded as positive, owing, as already stated, to irregularities in the stand of corn upon the different plots.

FIELD EXPERIMENTS WITH PHOSPHORAL UPON TURNIPS.

BY FRANK ATMAN, NEW BRUNSWICK, MIDDLESEX COUNTY.

Number of Plot.	Fertilizers Used Per Acre.	Kind and Quantity of Plant-Food Per Acre.	YIELD PER ACRE.	
			Pounds of Turnips.	Bushels of Turnips.
1	No Fertilizer........................	....	7,800	130.0
2	Precipitated Plaster, 180 lbs....	Sulphate of Lime, 164 lbs...	10,220	170.3
3	Floats, 250 lbs....................	Phospheric Acid, insoluble, 60 lbs................	11,000	183.3
4	Phosphoral, 185 lbs..............	Phosphoric Acid, available at 150° Fahr., 60 lbs. Phosphoric Acid, insoluble, 31.4 lbs..............	13,740	229.0
5	Precipitated Phosphate of Lime, 255 lbs...............	Phosphoric Acid, available at 100° Fahr., 60 lbs. Phosphoric Acid, insoluble, 9.4 lbs.................	14,360	239.3
6	Bone-Bl'k Superphosphate, 340 lbs.........................	Sulphate of Lime, 163 lbs. Phosphoric Acid, soluble, 60 lbs.......................	13,120	218.6
7	Precipitated Plaster, 180 lbs. Floats, 250 lbs.................	Sulphate of Lime, 164 lbs. Phosphoric Acid, insoluble, 60 lbs.................	13,220	220.3
8	Precipitated Plaster, 180 lbs. Phosphoral, 185 lbs..........	Sulphate of Lime, 164 lbs. Phosphoric Acid, available at 150° Fahr., 60 lbs. Phosphoric Acid, insoluble, 31.4 lbs..............	13,580	226.3
9	Precipitated Plaster, 180 lbs. Precipitated Phosphate of Lime, 255 lbs...............	Sulphate of Lime, 164 lbs. Phosphoric Acid, available at 100°, 60 lbs........ Phosphoric Acid, insoluble, 9.4 lbs.................	13,520	225.3
10	Precipitated Plaster, 180 lbs. Floats, 250 lbs................. Muriate of Potash, 100 lbs. Sulphate of Ammonia, 145 lbs...............................	Sulphate of Lime, 164 lbs. Phosphoric Acid, insoluble, 60 lbs................. Potash, 50 lbs.............. Nitrogen, 30 lbs............	13,640	227.3

FIELD EXPERIMENTS WITH PHOSPHORAL UPON TURNIPS.—Continued.

BY FRANK ATMAN, NEW BRUNSWICK, MIDDLESEX COUNTY.

Number of Plot.	Fertilizers Used Per Acre.	Kind and Quantity of Plant-Food Per Acre.	YIELD PER ACRE.	
			Pounds of Turnips.	Bushels of Turnips.
11	Precipitated Plaster, 180 lbs. Phosphoral, 185 lbs.......... Muriate of Potash, 100 lbs.. Sulphate of Ammonia, 145 lbs..............................	Sulphate of Lime, 164 lbs. Phosphoric Acid, available at 150°, 60 lbs........ Phosphoric Acid, insoluble, 31.4 lbs............... Potash, 50 lbs.............. Nitrogen, 30 lbs...........	13,820	230.3
12	Precipitated Plaster, 180 lbs. Precipitated Phosphate of Lime, 255 lbs............... Muriate of Potash, 100 lbs. Sulphate of Ammonia, 145 lbs..............................	Sulphate of Lime, 164 lbs. Phosphoric Acid, available at 150°, 60 lbs........ Phosphoric Acid, insoluble, 9.4 lbs................ Potash, 50 lbs............... Nitrogen, 30 lbs...........	18,620	310.3
13	Bone-Bl'k Superphosphate, 340 lbs......................... Muriate of Potash, 100 lbs. Sulphate of Ammonia, 145 lbs..............................	Sulphate of Lime, 163 lbs. Phosphoric Acid, soluble, 60 lbs...................... Potash, 50 lbs.............. Nitrogen, 30 lbs............	18,640	310.7
14	No Fertilizer.......................	....	4,500	75.0

This farm lies upon the outskirts of New Brunswick, upon rather a sandy clay soil. It is loamy and easily worked.

A good hay crop was first removed and the sod then turned for turnips.

The fertilizers, mixed with moistened sawdust, were sown in furrows two feet nine inches apart and covered with an inch or two of soil. The seed, ruta bagas, were then drilled in these rows over the fertilizers. At the proper time the plants were thinned out as much as seemed necessary. The Station's chemist witnessed the application of the fertilizers on July 21st, and the weighing of the crop on November 10th.

A comparison of plots 1, 3, 4 and 5 indicates that all three forms of phosphoric acid exerted a favorable effect upon the turnips, but while the phosphoral excelled the floats, it was itself excelled by the precipitated calcium phosphate.

The comparison of plots 6, 7, 8 and 9 with plot 1, shows that all four forms of phosphoric acid, when combined with plaster, exercised a very favorable effect upon the crop.

The differences between the crops from plots 6, 7, 8 and 9 are not marked, the phosphoral and precipitated calcium phosphate being practically identical and superior to those from the bone-black superphosphate and floats.

When combined with nitrogen and potash the four forms of phosphoric acid again show marked effects upon the crop. The bone-black superphosphate and the precipitated calcium phosphate being practically equal, each excelling the floats and phosphoral by approximately eighty bushels; upon this basis the phosphoric acid in phosphoral and floats appears to be of marked agricultural value, but is nevertheless inferior to that in bone-black superphosphate and precipitated calcium phosphate by twenty-five per cent.

FIELD EXPERIMENTS WITH PHOSPHORAL UPON WHEAT AND RYE.

Two experiments upon rye and four upon wheat were successfully begun in the fall of 1885, upon six different farms in this State.

They resemble in all respects the experiments with phosphoral upon corn and turnips, reported above, and were planned with the same object in view, viz., to compare the phosphoric acid in phosphoral with that in other phosphates, and to test agriculturally the value of the citrate of ammonia method for distinguishing between different forms of phosphoric acid.

The results will be published in the next annual report of this Station.

FIELD TRIALS WITH WOOL WASTE AS A FERTILIZER FOR WHEAT.

The size of the compost heap upon a farm often serves as an index to the skill and energy of the farmer. Sods cut from fence corners, weeds gathered from fields, soil raked from around wood piles, and leaves from wood lots are often, with considerable labor, collected, composted with yard manure, and used with encouraging results.

In certain sections of the State, however, far more concentrated waste products can be obtained from cities and large towns, to which attention should be directed. Among these may be noted wool waste, leather scraps, glue waste, spent bone-black from vaseline works, &c., &c., samples of which have from time to time been examined with more or less care at this Station. Many such products exist in relatively small amounts, too small, perhaps, to attract the attention of fertilizer manufacturers. This very fact, however, places them within the reach of energetic farmers.

Wool waste in particular is worthy of attention, as experiments published in the last annual report of this Station indicate. In that report it was shown that sometimes very marked profits followed its use, and sometimes no effect at all was evident. As a possible explanation Dr. Volckert's opinion was quoted, which directs attention to the very large proportion of oil present in this waste, a point regarded by many as a sufficient ground for believing the statements that this waste sometimes lies in the ground for years in an undecomposed condition, in which, of course, it is worthless as plant food.

In its last report this Station also published the results of its efforts to increase the value of wool waste, by treating it with a refuse product containing caustic potash in excess. The experiment proved the value of wool waste upon wheat, but failed to show that the increased harvest was caused by the action of the caustic alkali, it being possible that the use of potash in some other less expensive form would have been followed by increased crops, without in any way affecting the quality of the wool waste. The experiment was therefore repeated, upon the College farm, in a manner which allows the effect of the caustic to be carefully studied, and at the same time admits of a comparison between the action upon wheat, of nitrogen from wool waste and nitrogen from ammonium sulphate.

The experimental plots were twelve feet wide and three hundred and sixty-three feet deep—in area, therefore, one-tenth of an acre; upon each, there were sixteen drill rows eight inches apart. The dividing lines or spaces between plots were approximately eighteen inches wide. The details of the experiment are given in the following table:

Number of Plot.	FERTILIZERS.		Method of Application.	YIELD PER ACRE.			
	Kind.	Amount per Acre.		Pounds of Wheat.	Bushels of Wheat.	Pounds of Straw.	Weight per Measured Bushel.
1	Nothing........................	....	....	945	15.9	855	62
2	Caustic Potash................	900 lbs.	Dissolved in water, mixed with coal ashes, and broadcasted.	955	15.9	1,645	60
3	Wool Waste....................	2,000 lbs.	Mixed with coal ashes and applied broadcast.	1,330	22.6	1,370	62
4	Caustic Potash............. Wool Waste.................	900 lbs. 2,000 lbs.	Caustic allowed to act in solution on wool waste for ten days and mixed with ashes, applied broadcast.	1,350	22.5	1,500	60
5	Caustic Potash............. Wool Waste.................	900 lbs. 2,000 lbs.	One day intervened between application of caustic dissolved and soaked into ashes and wool waste.	1,610	26.9	2,240	60
6	Caustic Potash............. Wool Waste................. Bone-Black Superphosphate......................	900 lbs. 2,000 lbs. 850 lbs.	Caustic dissolved and soaked into wool waste and applied broadcast, superphosphate drilled with the seed.	1,480	24.7	1,620	60
7	Caustic Potash............. Wool Waste................. Bone-Black Superphosphate......................	900 lbs. 2,000 lbs. 850 lbs.	Wool waste and superphosphate applied one day later than caustic.	1,540	25.7	2,060	61
8	Caustic Potash............. Sulphate of Ammonia.. Bone-Black Superphosphate......................	900 lbs. 700 lbs. 850 lbs.	Ammonium sulphate and superphosphate applied one day later than caustic.	1,620	27.0	2,680	60
9	Wool Waste................. Bone-Black Superphosphate......................	2,000 lbs. 850 lbs.	Wool waste mixed with coal ashes and applied broadcast, the superphosphate drilled with the seed.	1,680	28.0	1,820	61
10	Caustic Potash............. Bone-Black Superphosphate......................	900 lbs. 850 lbs.	Caustic dissolved in water, mixed with coal ashes and applied broadcast, superphosphate drilled with the seed.	1,350	22.6	1,750	60
11	Bone-Black Superphosphate......................	850 lbs.	Drilled with the seed.	1,580	26.3	1,820	61

In nearly every respect this experiment corroborates the conclusions from last year's trials, the very marked results from the superphosphate when used alone being the only exception; for this no explanation is attempted at present.

To learn the effect of wool waste used alone, compare plots numbered 3 and 1; by its use the grain was increased by nearly seven bushels, and the straw increased by more than five hundred pounds per acre. In the trial made in 1884, upon the same farm, under similar conditions, both grain and straw were also increased, the former by five bushels the latter by six hundred pounds per acre.

As stated above, in order to admit of the removal of the oil present in the waste, it was treated with caustic potash, which in the form of a waste product can be obtained in quantity at a reasonable price from dealers in fertilizer supplies.

In this experiment the caustic was dissolved in water and the wool waste thoroughly soaked in the solution and formed into piles; upon opening the piles twenty-four hours later a very strong smell of ammonia was noted; the waste was then covered with sifted coal ashes and the action allowed to continue ten days. At the end of that time the piles were thoroughly mixed with ashes and spread broadcast upon plots 4 and 6. Upon the same day caustic which had been previously dissolved in water and mixed with coal ashes, was sown broadcast upon plots 2, 5, 7, 8 and 10.

The following day wool waste was spread upon plots 5 and 7. In this way wool waste and caustic potash were spread upon the same plot, but no opportunity was offered for any marked action to occur between them; a strict comparison is therefore possible between the effects of wool waste, thoroughly treated with caustic, and wool waste, not soaked in the alkali, but still in position to affect plant growth in the presence of potash applied as caustic. The results may be seen by comparing plot 4 with 5, and plot 6 with 7.

In both cases the waste which had not been soaked in the solution of caustic potash gave the heavier returns both of grain and straw.

The gains caused by the action of the treated wool waste and phosphoric acid upon plot 6, were practically identical with the results reached with a similar mixture in 1884.

These results from the use of the caustic were unexpected; the only plausible explanation at present known is that as ferments cannot live in strongly alkaline solutions, the decomposition of the wool waste and the conversion of its nitrogen into nitric acid was either prevented or seriously retarded.

COMPARISON BETWEEN NITROGEN FROM WOOL WASTE AND NITROGEN FROM AMMONIUM SULPHATE.

It is claimed that nitrogen in fertilizers should be valued agriculturally only in proportion to the rapidity with which it is converted to nitric acid. Resting upon this claim, Prof. Dünkelberg, in 1880, stated that many forms of nitrogenous organic matter were preferable to sulphate of ammonia or to nitrogenous preparation, in which sulphuric acid is used, as this acid seriously retards the formation of nitric acid in the soil. The following trial was made to roughly test the position which raw wool waste should occupy relative to ammonium sulphate. In each case the amount of *nitrogen* used was the same. The wool waste containing *seven* per cent. and the sulphate of ammonia *twenty* per cent.

By comparing plots 6 and 7 in the preceding table the results of the trial will be evident. The yield of both grain and straw is heaviest from the sulphate of ammonia plots, in each case, however, by relatively trifling amounts, especially when the prices of the sulphate are compared with that of the wool waste; the sulphate costing seventy dollars per ton, and the wool waste at present being worth only one dollar for a *load* of approximately fifteen hundred pounds.

As a waste product with which to enrich compost heaps, wool waste can hardly be overestimated. As an absorbent it ranks very high; it therefore finds its most economical use in manure piles, in which practical farmers claim it is itself improved in quality, possibly because it there finds the conditions necessary for its own rapid decomposition.

SORGHUM.

I. FIELD EXPERIMENTS UPON THE COLLEGE FARM.
II. FIELD AND SUGAR HOUSE EXPERIMENTS AT RIO GRANDE.

An act of the Legislature defines the duties of this Station to be the promotion of practical and scientific agriculture, and the *development of unimproved lands*.

As thousands of uncultivated acres in several of the southern counties of this State are claimed to be unusually favored by climate and soil for sorghum plantations, a considerable amount of labor has been expended by Station officials in studying the growth of this crop, and in assisting to develop methods for extracting and crystallizing its sugar.

The work was begun in 1881, in response to a resolution introduced into the Senate by Senator Taylor. The plan adopted at that time has been steadily followed to date.

This plan was:

First—To study the effects of fertilizers upon sugar production.

Second—To call attention to the enormous wastes in extracting sugar by mills and to show that these wastes are unnecessary, by directing attention to the diffusion process.

The extensive experiment on sugar production at Rio Grande, Cape May county, was described in detail in the last Annual Report.

The Station officials, in 1881, 1882 and 1883, repeatedly visited this plantation, but made no attempts to experiment there until 1884; the most urgent questions up to that time being mechanical rather than chemical.

In 1884, however, preliminary work was reported, and in 1885 both field and sugar house experiments were successfully carried out, the detailed report of which appears upon subsequent pages.

The Station's work, therefore, falls under two heads:

I. Field experiments upon the College Farm;
II. Field and Sugar House Experiments at Rio Grande.

I.

FIELD EXPERIMENTS UPON THE COLLEGE FARM IN 1885.

In the work upon the College Farm the Station has studied varieties of cane as well as the effects of fertilizers upon sugar production.

VARIETIES.

During the season of 1885, the early orange, the early amber from western seed, and the early amber from eastern seed were again compared.

The early orange seed came from the Cape May plantation, that of the western amber was furnished by Prof. Henry, of the Wisconsin Experiment Station, and the eastern seed had been grown the previous season upon the College Farm.

The seed were planted May 20th upon a fairly good timothy and clover sod. No fertilizers were used in either case.

The plot planted with eastern amber measured one-tenth of an acre.

As the amount of western seed was limited, one-twentieth of an acre only could be planted; the stand, then, was not as heavy as was thought desirable.

The plot devoted to the orange cane measured nearly one-half an acre. Although the cane was thickly planted and nearly thirteen feet tall, it showed no tendency to lodge.

Its great drawback, late ripening, was this season, in a measure, overcome, a small quantity of mature seed being secured. Judging from the condition of the greater part of the seed, however, the cane was far from ripe when it was harvested, October 5th, 1885. The amber cane on that date appeared to be quite ripe.

The results of the experiment are tabulated below:

	NO FERTILIZER.		
	Eastern Amber.	Western Amber.	Orange.
Pounds of unstripped and untopped cane per acre	29,190	19,322	41,304
Per cent. of sugar in unstripped and untopped cane	7.36	8.58	6.15
Total amount of sugar in pounds per acre	**2,148**	**1,658**	**2,540**
Percentage of leaves	10.0	7.7	12.5
Per cent. of stripped and topped cane	82.0	82.8	83.3
Per cent. of sugar in stripped and topped cane	8.98	10.4	7.38
Bushels of clean, dry seed per acre (56 pounds)	19.7	13.9	....
Bushels of seed per ton of cane	1.35	1.44	....

The effects of too light a "stand" are clearly seen in the case of the western amber, its canes were very rich, but in total yield of sugar per acre it compares unfavorably with the other varieties.

The enormous yields of orange cane from unmanured ground increases the desire to adopt this variety to the shorter seasons of counties lying north of Cape May.

EFFECTS OF FERTILIZERS DURING THE SEASON OF 1885.

Uniform plots of one-tenth of an acre each were measured off upon sod ground on the College Farm. These plots were three hundred and sixty-three feet deep and twelve feet wide, allowing four long rows of sorghum upon each.

The fertilizers were thoroughly mixed with moistened sawdust, then sown broadcast and harrowed in. The kind and quality used upon each plot is shown in a table upon a following page. The seed were drilled upon the 20th of May; this date is at least one week later than that of former trials; the crop was also harvested one week earlier than usual.

During the growing season no marked differences were noticeable until the seed began to form, when plot 14, upon which an excessive amount of phosphoric acid was used, at once appeared in advance of the others, and doubtless could have been harvested safely many days before the rest of the field.

The samples of cane were drawn from each plot and prepared for analysis upon the 5th of October.

The methods by which this work was done have been frequently published in former reports, and may again be found upon subsequent pages devoted to the experiment at the Rio Grande plantation.

It will be noticed in the table that no analysis is credited to plot 10. A defect in the steam desiccator, in which the samples were prepared, damaged the sorghum representing this plot to such an extent that the analytical results seemed thoroughly unreliable.

EXPLANATION OF TABLE A.

The following table may be studied from five standpoints:

1. To what extent and at what expense has sugar production been increased by fertilizers.
2. Is the increased amount of sugar per acre due to improvements in the quality or to gains in the quantity of cane.
3. What element exerts most marked influence upon sugar production.
4. What effect followed the use of phosphoric acid.
5. Is the sulphate or muriate of potash to be preferred in the cultivation of sorghum.

1.

By comparing plots 2, 3 and 4 with plot 1, it may be seen that nitrogen increases the total amount of sugar per acre by two hundred and seventy-one pounds. The increase caused by phosphoric acid was two hundred and eighty-four pounds, and that due to potash was two hundred and fifty-eight pounds. These three elements of plant-food in this experiment, therefore, closely resemble each other in their effects upon sugar production.

The effects of combinations of these elements may be studied by comparing plots 5, 6, 7 and 8 with No. 1.

Nitrogen and phosphoric acid upon plot 5 gave a smaller yield of sugar per acre than the unmanured plot, while the increase from nitrogen and potash combined was three hundred and seventy pounds.

Phosphoric acid added to potash, plot 7, had no influence upon sugar production, and the further addition of nitrogen to this combination—plot 8—was followed by a decrease of more than one hundred pounds of sugar per acre.

The heaviest increase of sugar, therefore, was caused by the use of nitrogen and potash—plot 6.

The increase in seed, eight bushels per acre, was also heaviest upon this plot. As clean, well cured seed can be sold for forty cents per bushel, the value of the increase therefore amounted to three dollars and twenty cents per acre. The fertilizers upon this plot cost seven dollars per acre; it leaves, therefore, three dollars and eighty cents as the expense of producing an increase of three hundred and seventy pounds of sugar, or a trifle more than *one cent per pound.*

Muriate of potash upon plot 4, at a total expense of three dollars, gave an increase of two hundred and fifty-eight pounds of sugar and five and one-third bushels of seed per acre. The increased amount of seed is valued at two dollars and twelve cents, leaving *eighty-eight cents* as the outlay for two hundred and fifty-eight pounds of sugar, or *one-third of one cent per pound.*

The muriate of potash, therefore, was the most profitable form of plant-food used in this experiment.

2.

On plots 2, 3 and 4, the increased amounts of sugar are practically due entirely to improvements in the quality of the cane.

Upon plots 8 and 9, however, the increase in each case is due only to tonnage, the quality of the cane upon these plots being inferior to that from plot 1.

Eighty per cent. of the increase upon plot 6 and ninety per cent. of that upon plot 7 was also caused by heavier yields of cane per acre.

3.

From this year's results it is not clear which of the two elements, potash or nitrogen, had most effect upon sugar production. When used alone nitrogen excelled slightly, but in combination the potash appears to have been most efficient. Compare plots 5 and 7.

4.

It has been already stated that in this experiment the seed were planted one week later, and that the crop was harvested one week earlier than usual. The season was therefore shortened by two weeks, and to this fact is at present charged the unusually favorable result noted in two or three cases from the use of phosphoric acid. Alone, it slightly excelled both nitrogen and potash, but combined, upon plot 5, its usual unfavorable effect was distinctly seen. This effect is also only slightly less marked upon plot 7.

Combined also with nitrogen and sulphate of potash, upon plot 13, the action of phosphoric acid has been decidedly favorable, but when the quantity of this acid was doubled the usual marked decrease in yield is again evident. Compare plots 14 and 13.

It has, however, been already stated that the cane upon plot 14 ripened many days in advance of that upon the other plots.

Where seasons are short, therefore, or where it is desirable to secure a part of a crop very early in the fall, superphosphates may be extremely valuable.

5.

When combined with phosphoric acid, the yield of sugar from the muriate excelled that from the sulphate by one hundred and thirty-seven pounds. When combined with nitrogen, however, the sulphate surpassed the muriate by forty-seven pounds of sugar per acre; the sulphate, however, in each case gave the richest cane.

The comparison between plots 13 and 8 is decidedly in favor of the sulphate, both as regards the quantity and quality of the crop. The excessively high price charged for the sulphate, however, is one great drawback to its use, for allowing full value for the increased yield of seed the gain in sugar upon plot 13 is secured at an expense of nearly one and eight-tenths cents per pound, being five times as costly as the increase from muriate of potash when used alone, upon plot 4.

SUMMARY OF FIELD EXPERIMENTS

For the Years 1881, 1882, 1883, 1884 and 1885.

Each experiment was made upon sod ground on widely different sections of the College Farm.

The table marked B furnishes the data for the following conclusions.

WEIGHTS OF SORGHUM PER ACRE.

1. Without exception, under all the varying conditions of soil and seasons, muriate of potash used alone has noticeably increased the total weight of the sorghum crop.

2. Without exception, this increase has each year exceeded that caused by phosphoric acid and nitrogen, used either alone or combined with each other.

3. With a single exception, 1885, this increase has each year exceeded that caused by a combination of phosphoric acid and potash.

4. With two exceptions, this increase has exceeded that caused—

a. By combinations of nitrogen and potash. (See 1884 and 1885.)

b. By combinations of nitrogen, phosphoric acid and potash. (See 1882 and 1885.)

c. By a dressing of twenty tons per acre of barn-yard manure. (See 1884 and 1885.)

YIELD OF SUGAR PER ACRE.

1. Without exception, muriate of potash has noticeably increased the total yield of sugar per acre.

2. Without exception, this increase has exceeded that caused by a combination of nitrogen and phosphoric acid.

3. Without exception, this increase has exceeded that caused by combinations of nitrogen, phosphoric acid and potash.

4. With a single exception, this increase has exceeded that caused by combinations of phosphoric acid and potash.

5. The total yield of sugar per acre, grown with the aid of muriate of potash, has been exceeded in two cases out of three by a combination of nitrogen and potash; it has also been exceeded in all cases

by the yield from plots fertilized with barn-yard manure; in no case, however, has this excess been greater than six per cent.

It appears, therefore, to be demonstrated for the College Farm—

First—That muriate of potash has a positive and favorable effect upon the growth of sorghum.

Second—That muriate of potash, in most cases, has influenced the weight of the cane to a greater extent when used alone than when used in combination with other elements of plant-food.

Third—That potash combined with nitrogen in two cases out of three has produced the heaviest yields of sugar.

The results of a single experiment upon the Cape May plantation have been tabulated with those from the College Farm, and strikingly corroborate most of the above conclusions.

TABLE A.

COLLEGE FARM—EARLY AMBER SORGHUM.

Tonnage of Cane—Sugar and Seed per Acre.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
					Potash as Muriate.					Potash as High Grade Sulphate.						
FERTILIZERS. KIND AND QUANTITY USED PER ACRE.	No Fertilizer.	Nitrogen, 22.5 lbs. from Nitrate of Soda.	Phosphoric Acid, 52.5 lbs. from Bone Black Superphos.	Potash, 75 lbs. from Muriate of Potash.	Nitrogen 22.5 lbs. Phos. Acid, 52.5 "	Nitrogen, 22.5 lbs. Potash, 75.0 "	Phos. Acid, 52.5 lbs. Potash, 75.0 "	Nitrogen, 22.5 lbs. Phos. Acid, 52.5 " Potash, 75.0 "	Barn-yard Manure, 20 Tons.	Potash, 80 lbs. from Sulphate of Potash.	Potash, 80 lbs. Phos. Acid, 52.5 "	Potash, 80 lbs. Nitrogen, 22.5 "	Potash, 80 lbs. Nitrogen, 22.5 " Phos. Acid, 52.5 "	Potash, 80.0 lbs. Nitrogen, 22.5 " Phos. Acid, 105.0 "	Land Plaster, 400 lbs.	No Fertilizer.
Cost of Fertilizers per acre..............................	....	$4.05	$3.67	$3.00	$7.72	$7.00	$6.67	$10.72	....	$4.20	$7.87	$8.25	$11.92	$15.59	$1.50	....
Pounds of unstripped and untopped cane per acre.....................	29.190	29.325	28.820	29.700	28.995	33.005	32.455	31.653	34.670	27.510	29.580	30.605	33.010	32.225	28.160	28.860
Per cent. of sugar in unstripped and untopped cane..............	7.36	8.25	8.44	8.10	7.20	7.63	7.43	6.96	6.81	....	7.70	8.38	8.00	7.94	7.22	7.71
Total Amount of Sugar in pounds per acre.................	**2148**	**2419**	**2432**	**2406**	**2088**	**2518**	**2411**	**2303**	**2561**	....	**2274**	**2565**	**2641**	**2549**	**2033**	**2225**
Percentage of Leaves...	10.0	8.8	6.6	7.3	7.6	7.5	8.6	11.4	13.9	9.5	9.4	11.2	10.4	10.7	14.6	11.0
Per cent. of stripped and topped cane...	82.0	83.9	84.3	84.0	83.8	84.3	83.6	80.3	79.4	83.6	81.8	80.8	80.4	80.2	77.6	80.9
Per cent. of sugar in stripped and topped cane..............................	8.98	9.83	10.00	9.64	8.54	9.04	8.88	8.66	8.58	....	9.41	10.24	9.95	9.90	9.82	9.58
Bushels clean dry seed per acre (56 lbs.).........	19.7	18.5	20.1	26.0	24.0	27.8	21.8	26.0	24.4	19.5	27.0	21.4	29.4	30.7	18.0	20.8

TABLE B.

EARLY AMBER SORGHUM.

Summary of Experiments made in 1881, 1882, 1883, 1884 and 1885.

KIND AND QUALITY OF FERTILIZERS USED PER ACRE.	Year.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
							Potash as Muriate.				Potash as High Grade Sulphate.						
		No Fertilizer.	Nitrogen, 22.5 lbs. from Nitrate of Soda.	Phosphoric Acid, 52.5 lbs. from Bone Black Superphos.	Potash, 75 lbs. from Muriate of Potash.	Nitrogen, 22.5 lbs. Phos. Acid, 52.5 "	Nitrogen, 22.5 lbs. Potash, 75.0 "	Phos. Acid, 52.5 lbs. Potash, 75.0 "	Nitrogen, 22.5 lbs. Phos. Acid, 52.5 " Potash, 75.0 "	Barn-yard Manure, 20 Tons.	Potash, 80 lbs. from Sulphate of Potash.	Potash, 80 lbs. Phos. Acid, 52.5 "	Potash, 80 lbs. Nitrogen, 22.5 "	Potash, 80 lbs. Nitrogen, 22.5 " Phos. Acid, 52.5 "	Potash, 80.0 lbs. Nitrogen, 22.5 " Phos. Acid, 105.0 "	Land Plaster, 400 lbs.	No Fertilizer.
Pounds of Sorghum per acre, College Farm	1881	11515	14820	13365	16000	14440	12890	11640	12590	12375	11605	11650	12505	13260	14030	12680	11170
" " " " " " "	1882	29840	31670	28180	33320	32020	36370	31750	37420	29700	24320	28830	26030	31560	32800	30920	29740
" " " " " " "	1883	31040	31930	35200	39390	33530	36780	33680	32860	38590	36740	29790	36820	33600	33180	32820	33220
" " " " " " "	1884	24850	26373	27889	29972	28075	28993	27928	27802	32571	24685	24617	21275	22218	20066	24949	23689
" " " " " " "	1885	29190	29325	28820	29700	28995	33005	32455	31653	34670	27510	29530	30605	33010	32225	28160	28860
" " " " " Rio Grande	1885	....	38210	34330	39170	37650	44370	39820	39920	35050	33640	38770	34060	34350	32420	19610	20340
Total amount of sugar in pounds per acre, College Farm	1883	3872	3542	3830	3963	3260	4582	3855	3452	4119	4248	3838	4866	4547	4809	4215	3426
Total amount of sugar in pounds per acre, College Farm	1884	1829	1703	1739	2041	1801	1978	1832	1953	2135	1733	1544	1338	1587	1472	1744	1609
Total amount of sugar in pounds per acre, College Farm	1885	2148	2419	2432	2406	2088	2518	2411	2303	2561	....	2274	2565	2641	2549	2083	2225
Total amount of sugar in pounds per acre, Rio Grande	1885	....	2744	2595	2930	2477	3234	2848	2994	2194	2523	2782	2830	2590	2419	1267	1255
Pounds of clean seed per acre	1881	1020	1298	1351	1246	1844	1067	1038	1866	1160	1216	1226	1189	1849	1278	1186	1182
" " " " " "	1882	1095	785	620	870	880	490	820	295	290	500	670	470	680	790	290	510
" " " " " "	1883	1770	1462	1898	2190	1842	9055	1887	1887	2128	1904	1400	1868	1546	1658	1680	1725
" " " " " "	1884	1534	1736	1495	1876	1764	1966	2016	1876	2088	1691	1596	1889	1462	1462	1456	1422
" " " " " "	1885	1103	1036	1126	1400	1844	1557	1220	1456	1866	1092	1512	1198	1646	1719	1008	1165

II.

FIELD AND SUGAR HOUSE EXPERIMENTS AT RIO GRANDE, CAPE MAY COUNTY.

I.—Brief history of the Rio Grande plantation for the season of 1885.
II.—The effect of commercial fertilizers,
    1. Upon the growth of sorghum;
    2. Upon its yield of sugar per acre and per ton of cane.
III.—Milling and diffusion compared, as methods of separating sugar from sorghum,
    1. Mill products from unstripped cane compared with diffusion products from stripped cane;
    2. Diffusion products from stripped cane compared with diffusion products from unstripped cane.
IV.—General summary of results.

I.

BRIEF HISTORY OF THE RIO GRANDE PLANTATION FOR THE SEASON OF 1885.

The history of the past season at Rio Grande is essentially the same as that of previous years. There has been the same honest effort to reduce working expenses, to discover and avoid wastes, to improve processes, and, in brief, to do everything possible to place this huge experiment upon a strict business basis. The success has been quite as marked as could be expected, and at no time in the history of this plantation have its prospects appeared so bright.

In 1884, phosphates were used upon the crop; in consequence it ripened much earlier than had been expected, and throughout the season the fields were in advance of the sugar house, over-ripe cane only being delivered at the mill.

In 1885, the opposite course was followed, no phosphates were used, and during the first half of the milling season the sugar house was in advance of the fields, the cane at times being so green that more than once it was almost decided that the house must be closed until ripe cane could be secured. The marked improvements in the clarification of mill juice not only prevented a failure, but even kept the average yield of merchantable sugar, per ton of unstripped and untopped cane, quite up to that of the previous year.

At present the mill is the greatest drawback to the sorghum sugar industry; an experiment upon a large scale, published later in this report, indicating that it fails to secure at least one-half of the sugar existing in the cane. A similar record was made in the last annual report of this Station.

That report also contained the results of an experiment showing that diffusers were much superior to mills, as they wasted approximately five per cent. only of the total sugar. Unfortunately, however, diffusion extracts dark-colored and bitter-tasting compounds from unstripped sorghum, which make the products almost unsalable; it seemed necessary, therefore, for the present at least, to retain the mill.

It was, however, surmised that both color and taste came from leaves and leaf sheaths. Superintendent Hughes therefore devised a machine by which the cane could be thoroughly and rapidly stripped. His model and plans were submitted to a number of mechanical engineers, whose verdict was that the machine should be constructed. This, for various reasons, was not immediately undertaken, and the past season has been devoted to proving that such a machine is essential to success. The details are given upon subsequent pages.

Although, from previous trials, it was reasonably certain that the product would be of low grade, it was still deemed best to again operate the diffusion battery upon mill bagasse, for defects in the apparatus, errors in its manipulation, and all other drawbacks could be discovered by diffusing almost worthless material quite as well as by working valuable cane; the regular "run" of the house, too, would not be disturbed by this arrangement.

The diffusers were therefore used for twenty-six days, and two hundred and twenty-nine barrels of heavy syrup were secured; as expected, it was of medium quality only, but still merchantable for enough to more than pay experimental expenses. It was found by experiments with a ton of bone-black, that the dark color and bitter taste could be removed, the undesirable bone-black flavor, however, was substituted. The exhaustion of the bone-black also was judged to be too rapid to admit of its profitable use.

A practically automatic apparatus for filling diffusers was devised, tested and found in all respects thoroughly efficient. The difficulty in removing the spent bagasse from the cells in a great measure disappeared as the experience and skill of the workmen increased, no noticeable delay in working the battery resulting from this source.

No cane was purchased this season, all that was milled having been grown upon the company's plantation, 960 acres yielding 7,420 tons of unstripped and untopped sorghum. Out of this, 281,000 pounds of merchantable sugar, 50,000 gallons of syrup and from 9,000 to 10,000 bushels of seed were secured, these products finding a ready market at satisfactory prices.

The records of this plantation for the past five years show that, upon the average, seven and seven-tenths tons of unstripped and untopped cane only have been grown per acre, while the average yield of merchantable sugar per tone of cane has not exceeded forty pounds.

To compete successfully with other sources of cane sugar, therefore, the average tonnage of good cane per acre should be at least doubled, while the quantity of merchantable sugar secured per acre should be increased many fold.

The possibility of accomplishing both objects at Rio Grande can be seen from the following experiments, planned by the Station for this plantation. The expenses of the trials were willingly borne by Mr. George C. Potts. The success is largely due to the hearty cooperation and earnest work of Superintendent Henry A. Hughes.

II.

THE EFFECTS OF COMMERCIAL FERTILIZERS.

1. *Upon the growth of sorghum.*
2. *Upon its yield of sugar per acre and per ton of cane.*

The field selected for this experiment is level, uniform in quality and protected from northeast storms by a heavy strip of woodland several hundred feet distant.

Its soil is a very sandy loam, easily worked and responsive to fertilizers. For several years in succession it has been cropped with sorghum, but has never been rated high in fertility.

Before arrangements had been made for this trial the field had been dressed with a compost made of four tons of mill bagasse to one ton of yard manure. This had been spread uniformly at the rate of five tons per acre.

Upon this field a surveyor measured a tract five hundred and forty-eight feet long and one hundred and forty-five and two-tenths feet broad. This was bounded upon the northeast by a fence and upon the southwest by a farm road; upon the northwest and southeast it was isolated from the rest of the field by lanes four feet wide. A headland, from six to eight feet wide, was left at one end of each plot; this afforded an opportunity, in cultivating, to turn the horses without damage to canes at the ends of the rows. The farm road running across to other end of each plot answered a similar purpose.

This tract was first prepared as if intended for Indian corn. By means of lanes four feet wide it was then divided into sixteen plots, each one-tenth of an acre in area.

The fertilizers were sown broad-cast and harrowed in; the quantities and combination used upon each plot, as well as the cost of the material, can be found in the following table. As in former experiments made by this Station, phosphoric acid was used in the form of bone-black superphosphate, and nitrogen in the form of nitrate of soda; muriate of potash was applied to some of the plots and sulphate of potash to others. Two tons of yard manure was spread upon plot 9, and forty pounds of land plaster upon plot 15. Two plots, Nos. 1 and 16, were left without fertilizers, in order to learn what the soil alone was able to produce.

On the 22d of April, early orange seed was planted in rows three feet apart, making ten rows upon each plot. The plants were thinned out as much as was necessary and cultivated twice during the season; late cultivation was avoided, as this is believed to be injurious, particularly to seed development.

Owing to a misunderstanding, instead of three feet, the rows upon plot 1 were drilled three and one-half feet apart; there were also indications that several of these rows were upon the edge of a former compost bed. This plot was therefore abandoned and comparisons of the effects of fertilizers must be drawn against plot 16 alone.

The Effects of Commercial Fertilizers upon the Growth of Sorghum.

For several years Mr. Henry A. Hughes, superintendent of the Rio Grande plantation, has been keeping a careful weekly record of the development of the cane upon each field; this system he also introduced into this experiment. The following interesting and instructive table is copied from his note book.

The table shows that six weeks from the date of planting the canes stood from two to three inches only above the ground. This "moping" characterizes both sorghum and oats; it is their time for root development. Fertilizers in this experiment seem to have had no power to shorten this period.

Nitrogen alone was used upon plot 2; phosphoric acid upon plot 3, and potash upon plot 4. Plot 16 was cropped without fertilizers. At the close of the week ending June 23d, a comparison of the records of these four plots indicates no marked differences in the relative growth of the plants.

Rio Grande Plantation—Early Orange Sorghum.

WEEKLY RECORD OF DEVELOPMENT, EXPRESSED IN INCHES.

FERTILIZERS. KIND AND QUANTITY USED PER ACRE.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						Potash as Muriate.				Potash as High Grade Sulphate.						
		Nitrogen, 22.50 lbs. from Nitrate of Soda.	Phos. Acid, 52.50 lbs. from Bone Black Superphos.	Potash, 75.00 lbs. from Muriate of Potash.	Nitrogen, 22.50 lbs. Phos. Acid, 52.50 "	Nitrogen, 22.50 lbs. Potash, 75.00 "	Phos. Acid, 52.50 lbs. Potash, 75.00 "	Nitrogen, 22.50 lbs. Phos. Acid, 52.50 " Potash, 75.00 "	Barn-yard Manure, 20 Tons.	Potash, 80.00 lbs. from Sulphate of Potash.	Potash, 80.00 lbs. Phos. Acid, 52.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 " Phos. Acid, 52.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 " Phos. Acid, 105.00 "	Land Plaster, 400 lbs.	No Fertilizer.
		In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
June 2d	....	2.50	2.75	2.75	2.25	2.50	2.25	2.50	3.00	2.50	2.25	2.50	2.50	2.50	2.00	2.50
June 9th	....	3.50	3.50	4.50	3.50	3.50	3.25	3.50	4.00	4.00	4.00	3.75	4.00	4.00	3.50	3.25
June 16th	....	5.50	4.50	5.00	4.50	5.00	5.00	4.50	5.50	5.00	5.00	4.50	5.00	6.00	4.50	4.00
June 23d	....	11.00	9.00	10.00	9.00	12.00	10.00	10.00	12.00	9.00	9.00	10.00	11.00	13.00	8.00	8.00
June 30th	....	18.00	14.00	14.00	14.00	18.00	14.00	15.00	19.00	14.00	14.00	15.00	18.00	22.00	12.00	13.00
July 7th	....	29.00	23.00	23.00	24.00	27.00	25.00	26.00	30.00	23.00	27.00	26.00	28.00	31.00	21.00	21.00
July 14th	....	36.00	31.00	28.00	29.00	35.00	32.00	31.00	35.00	29.00	34.00	34.00	38.00	39.00	28.00	27.00
July 21st	....	52.00	44.00	41.00	37.00	46.00	37.00	44.00	50.00	37.00	44.00	44.00	48.00	51.00	32.00	34.00
July 28th	....	72.00	56.00	57.00	53.00	62.00	56.00	62.00	66.00	55.00	59.00	61.00	61.00	67.00	42.00	45.00
August 4th	....	80.00	67.00	70.00	68.00	78.00	66.00	75.00	79.00	68.00	69.00	75.00	76.00	80.00	58.00	55.00
August 11th	....	89.00	80.00	90.00	76.00	92.00	77.00	87.00	90.00	85.00	82.00	90.00	87.00	90.00	60.00	63.00
August 18th	....	108.00	96.00	108.00	86.00	104.00	91.00	97.00	100.00	100.00	96.00	100.00	100.00	107.00	67.00	76.00
August 25th	....	113.00	106.00	116.00	100.00	114.00	100.00	107.00	109.00	109.00	106.00	114.00	110.00	118.00	84.00	86.00
No. tons unstripped and untopp'd cane harvested per acre	....	19.11	17.17	19.59	18.88	22.19	19.91	19.96	17.58	16.82	16.89	17.08	17.18	16.21	9.81	10.17

During this week, the tenth from the date of planting, upon all of the plots, the plants increased in height by one hundred per cent.

From this date the effect of nitrate of soda became more and more marked, until at the close of the week ending July 28th its plants were fifteen inches taller than those upon plots 3 and 4 and twenty-seven inches taller than those upon the unmanured plot, No. 16. This date closed the fifteenth week from the time of planting.

At this point muriate of potash began to exert the most marked effect, and at the close of the week ending August 11th its plants were quite as tall as those upon the nitrate of soda plot. Upon August 25th, the date of the close of this record, the canes upon muriate of potash plots were three inches taller than those upon the nitrogen plots, ten inches taller than those upon the phosphoric acid plot, and thirty inches taller than those upon the unmanured plot, No. 16.

With the exception of No. 14, the cane upon the muriate of potash plot (No. 4) was the tallest in the experiment; next in order stood that which had been grown with a combination of nitrogen and potash (No. 6), and last of all, that which had been fertilized with nitrogen and phosphoric acid (No. 5), and phosphoric acid and potash (No. 7).

At the time of harvest, October 11th, the cane upon the muriate of potash plot appeared still to be the tallest in the experiment, being rivaled only by that upon plots 6 and 14. It is estimated that in these three cases the cane stood between eleven and twelve feet high.

Potash, phosphoric acid and nitrogen all react favorably upon sorghum growing upon this plantation; potash, however, commercially the cheapest element, exerts the most marked effect.

Records similar to these are of great value in studying the effects of fertilizing elements at different stages in plant growth. At Rio Grande they have been extremely serviceable in comparing a growing crop at any given time with previous crops from the same field. Such records, however, should not be used as *standards* for determining the value of fertilizers for cane production. For instance, of all the fertilized plots, that with the tallest cane (No. 14) yielded the smallest tonnage per acre. The largest tonnage per acre came from plot 6, which, in height, ranked third only. The cane from plot 7 equaled in weight that from plots 4 and 8, yet it was the shortest of the three, in one case by sixteen inches, and in the other by seven inches.

The Effects of Commercial Fertilizers Upon the Yield of Sugar Per Acre and Per Ton of Cane.

In order to determine the effects of fertilizers upon sugar production, a representative sample was drawn from each plot and its total sugar determined by analyses. This, with the total weight of cane, furnished all necessary data.

SAMPLING.

It has been already indicated that in each experiment there were ten rows, each row being one hundred and forty-five feet long. It was decided that all canes, large and small, should be taken from approximately one-third of one row, to represent the sorghum growing upon that plot. Upon the 7th and 8th of October this was done, in every case personally, by Superintendent Hughes and the chemist of this Station. The samples varied in weight from seventy-four to one hundred and thirty pounds.

After the seed tops and leaves, exclusive of sheaths, had been removed and weighed separately, the canes were cut into half inch pieces and shredded into a Lion cutter and crusher. Sub-samples were then drawn and thoroughly dried at 120° Fahr. From these dried samples portions for analyses were ground in a mill until fine enough to pass through a sieve twelve mesh to the inch.

The sugar was separated from the fiber with boiling alcohol, and after the removal of the alcohol and clarification with basic lead acetate, the solutions were polarized according to Clerget's method.

EXAMINATION OF ANALYTICAL METHODS.

The fact that manufacturers hitherto have been able to secure relatively only a small amount of sugar even from rich cane, has naturally awakened a suspicion that the polariscope may give incorrect results when used upon sorghum solutions.

This suspicion is strengthened by the knowledge that many other substances resemble sugar in its effect upon polarized light, and that several compounds of this class have actually been detected in the sugar beet. The question therefore arises—*was sugar the only active substance present in the clarified solutions from the Station's samples?*

Sugar dissolved in water turns a ray of polarized light *to the right,* in proportion to the concentration of the solution. If the solution is strongly acidified and heated to 65° C., the sugar will be destroyed, but the products of its decomposition turn a ray of polarized light *to the left,* the degree of rotation depending both upon the concentration of the solution and its temperature. If polarized, when heated to a point between 86° and 90° C., the solution becomes inactive, having no more effect upon polarized light than pure water.

Of all optically active substances at present known, sugar alone is affected in this manner by acids and heat. It is, therefore, a relatively easy matter to answer the above question.

The polariscope indicated 62.8° *to the right,* when a solution was tested which contained 16.35 grammes of pure sugar in a definite volume of water.

It indicated 25.08° *to the left,* when the same solution, previously acidified and heated, was cooled to 8° C., and retested; when, however, the test was made at 90° C., the readings were 0.8° and 1° *to the right.* The observation tube was made of brass, gold plated to resist acids.

The solutions from the fifteen samples, taken as above described, were also tested at 90° C.; without exception, they too gave 0.8° rotation *to the right.*

The solutions, therefore, reacted as pure sugar solutions only can act. It is, therefore, reasonably certain that sugar was the only optically active compound present in the solutions from the Station's samples.

EXPLANATION OF THE FOLLOWING TABLE.

The following table may be studied from five standpoints:

1. To what extent and at what expense has sugar production been increased by fertilizers.
2. Is the increased amount of sugar per acre due to improvements in the quality or to gains in the quantity of cane.
3. What element exerts most marked influence upon sugar production.
4. What effect followed the use of phosphoric acid.
5. Is the sulphate or muriate of potash to be preferred in the cultivation of sorghum.

Rio Grande Plantation—Early Orange Sorghum.

TONNAGE OF CANE—SUGAR PER ACRE—SUGAR WASTED BY MILLING.

Fertilizers. Kind and Quantity Used per Acre.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						Potash as Muriate.				Potash as High Grade Sulphate.						
		Nitrogen, 22.50 lbs. from Nitrate of Soda.	Phos. Acid, 52.50 lbs. from Bone Black Superphos.	Potash, 75.00 lbs. from Muriate of Potash.	Nitrogen, 22.50 lbs. Phos. Acid, 52.50 "	Nitrogen, 22.50 lbs. Potash, 75.00 "	Phos. Acid, 52.50 lbs. Potash, 75.00 "	Nitrogen, 22.50 lbs. Phos. Acid, 52.50 " Potash, 75.00 "	Barn-yard Manure, 20 Tons.	Potash, 80.00 lbs. from Sulphate of Potash.	Potash, 80.00 lbs. Phos. Acid, 52.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 " Phos. Acid, 52.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 " Phos. Acid, 105.00 "	Land Plaster, 400 lbs.	No Fertilizer.
Cost of Fertilizers per acre..	....	$4.05	$3.67	$3.00	$7.72	$7.00	$6.67	$10.72	....	$4.20	$7.87	$8.25	$11.92	$15.59	$1.50	....
Per cent. of Leaves and Seed Tops......................	....	21.80	21.70	20.50	24.40	18.80	19.80	19.00	18.40	21.00	14.00	19.20	20.80	22.00	24.00	23.00
Pounds of unstripped and untopped cane per acre....	....	38210	34330	39170	37650	44370	39820	39920	35050	33640	33770	34060	34350	32420	19610	20340
Per c. of Total Sugar in unstrip'd and untop'd cane..	....	7.18	7.56	7.48	6.57	7.29	7.14	7.50	6.26	7.50	8.19	8.30	7.54	7.46	6.46	6.17
Total amount of Sugar in pounds per acre.......	....	**2744**	**2595**	**2930**	**2477**	**3234**	**2843**	**2994**	**2194**	**2523**	**2732**	**2830**	**2590**	**2419**	**1267**	**1255**
Gallons of Mill Juice per ton of uns'p'd & unt'p'd cane	....	77.10	87.70	81.20	83.50	83.10	77.40	81.90	83.60	83.80	70.20	75.90	76.90	84.10	75.00	90.90
Pounds of Mill Juice per ton of uns'p'd & unt'p'd cane	....	683	774	722	740	736	686	728	743	747	626	675	684	750	667	808
Pounds of Sugar in 100 lbs. of Mill Juice..................	....	8.69	8.23	9.96	8.89	9.70	9.48	9.96	9.12	11.30	11.21	11.38	11.16	11.03	8.87	9.18
Pounds of Sugar in Mill Juice from one ton of cane	....	59.40	63.70	71.90	65.80	71.40	65.00	72.50	67.80	84.40	70.20	67.80	76.30	82.70	59.20	74.20
Pounds of Sugar in Mill Juice per acre...............	....	**1135**	**1094**	**1409**	**1239**	**1584**	**1294**	**1447**	**1189**	**1420**	**1186**	**1308**	**1311**	**1241**	**581**	**755**
Per c. of Total Sugar secured by milling uns'p'd cane....	....	41.00	42.20	48.10	50.00	49.00	45.50	48.30	54.20	56.20	43.40	46.20	50.60	51.30	45.80	60.00
Per c. of Total Sugar wasted by milling unstrip'd cane	....	59.00	57.80	51.90	50.00	51.00	54.50	51.70	45.80	43.80	56.60	53.80	49.40	48.70	54.20	40.00
Tons of unstripped and untopped cane per acre.........	....	19.11	17.17	19.59	18.83	22.19	19.91	19.96	17.53	16.82	16.89	17.03	17.18	16.21	9.81	10.17

1.

By comparing plot 16 with plots 2, 3 and 4, it may be seen that nitrogen increased the sugar yield per acre by 1,489 pounds. The increase due to phosphoric acid was 1,340 pounds, while that due to muriate of potash was 1,675 pounds. As the unmanured plot gave but 1,255 pounds per acre, it is evident that the yield of sugar was more than doubled by the application of either nitrogen, phosphoric acid or potash.

The largest increase per acre was caused by the combination of nitrogen and potash upon plot 6. This amounted to 1,979 pounds. As the combination cost $7.00 per acre, the expense of the fertilizers can be estimated at three and one-half mills, only, per pound of sugar.

The use of muriate of potash alone was, relatively, even more profitable, 1,675 pounds of sugar resulting from an investment for fertilizers of $3 per acre. This investment therefore amounted to less than two mills per pound of sugar.

2.

The comparison of plot 16 with plots 2, 3 and 4, shows that the application of fertilizers was followed by an increase of from 7 to 9 tons of cane per acre. The percentage of sugar was also influenced by the fertilizers; the exact amount of this increase in each case can be learned by the following calculation:

Plot 6 yielded at the rate of 44,370 pounds of cane per acre. Had the quality of this cane simply equaled that from the unmanured plot, No. 16, its total yield of sugar would have been 2,638 pounds per acre (44,370 x 6.17 per cent.) The total yield from this plot was found, however, to be 3,234 pounds; the improvement in the quality of cane due to fertilizers was therefore 596 pounds of sugar. As the total gain upon this plot was 1,979 pounds, it follows that 30 per cent. of the increased yield of sugar resulted from improvement in the quality of the cane and 70 per cent. from gains in tonnage.

Muriate of potash used alone exerted exactly the same influence, 30 per cent. of its increased sugar yield being due to improvement in quality. Adopting these results as a temporary standard, and using the same method of calculation, it follows that phosphoric acid improved the quality of the cane at the expense of its quantity, while nitrogen increased the quantity at the expense of its quality. Barn-yard manure, plot 9, illustrates the extreme in this direction, its increase of 939 pounds of sugar per acre being due entirely to gains in tonnage; the quality of its cane being inferior to that from the unmanured plots.

3.

By referring to 4, 6, 7, 8 and 12, the only plots from which the sugar yield exceeded 2,800 pounds per acre, it may be noted that potash was the only element present without exception in every case. The conclusion is, therefore, that potash was the element which exerted most marked effect upon sugar production.

4.

By comparing plot 3 with 2 and 4, it is evident that phosphoric acid exerted less favorable influence upon sugar production than either nitrogen or muriate of potash. When it was combined with nitrogen, plot 5, the yield of sugar fell 267 pounds below that from nitrogen alone; when combined with muriate of potash, plot 7, the sugar yield fell 87 pounds below that from potash alone, and when combined with both potash and nitrogen, the sugar yield declined in both cases exactly 240 pounds. (Compare 8 and 13 with 6 and 12.) Further, when the quantity of phosphoric acid was doubled, an additional loss of 170 pounds of sugar occurred (plots 13 and 14). The same effect was equally noticeable in the College Farm experiments of 1883. Phosphoric acid in comparison with the other fertilizing elements in every case positively decreasing the amount of sugar per acre.

The opinion at present entertained is that this element hastens the ripening of the plants, and that in the above experiment the report would have been favorable for phosphoric acid had the samples been drawn and the experiment closed two or three weeks earlier in the season.

5.

As far as tonnage of cane and weight of sugar per acre are concerned, muriate of potash and its combinations in all cases excel the sulphate of potash; the highest percentages of sugar, however, were found in canes from sulphate of potash plots.

The calculations used above may be also employed to indicate the effect of the sulphate, compared with that of the muriate, upon the quality of cane.

In case of plot 6, 30 per cent. of the increased sugar yield was due to improvements in quality; in case of plot 12, 40 per cent. of the increased sugar yield was due to improvements in the quality of the cane; in this respect, therefore, the sulphate excels the muriate. The importance of securing cane with the highest possible percentage of sugar is noted in discussing diffusion later in the report.

In order to test the differences between canes fertilized with muriate and sulphate of potash—two large tracts, one eight and one-half acres, the other nine acres, were taken for experiment. These areas were selected in order to have material enough for a "strike" from the large vacuum pan.

For five years in succession these fields had been cropped with sorghum, but in all cases the yield of cane had been unsatisfactory.

A plain superphosphate made from bone-ash was sown broadcast on both tracts at the rate of 200 pounds per acre. In addition to this, 200 pounds of muriate of potash per acre was used upon one field and an equivalent amount of potash, in the form of high grade sulphate, upon the other field.

The muriate of potash tract yielded fourteen tons, and the sulphate of potash tract nearly eleven tons per acre.

The cane from each plot was milled and its juice handled separately. The sugar boiler, Mr. Schatte, claimed that the "pan" from the "muriate" cane was the best one of the season; the yield of sugar was sixty pounds per ton of unstripped and untopped sorghum.

The mill juice from the cane grown with sulphate of potash was very dark colored and could not be properly clarified by the usual method; for this reason it boiled badly in the vacuum pan and the experiment was abandoned.

The cause of this trouble may be entirely foreign to the fertilizers, but the higher price of the sulphate and its relatively low yields of sugar per acre, at present outweigh its heavier yield of sugar per ton of cane.

Briefly the effects of fertilizers may be summed as follows:

A. In nearly every case the yield of sugar per acre was doubled by the use of either nitrogen, phosphoric acid or potash; in one case (plot 6) the increase was 157 per cent.

B. Of all of the elements, potash in the form of muriate exerted most marked effect upon the yield of sugar per acre; its best results being secured when it was combined with nitrogen.

In the form of sulphate, potash affected most favorably the yield of sugar per ton of cane; its best result was also secured when it was aided by nitrogen.

III.

MILLING AND DIFFUSION COMPARED AS METHODS FOR SEPARATING SUGAR FROM SORGHUM.

After the cane from the fifteen experimental plots had been weighed, each portion was separately topped with a guillotine and milled.

When desirable, the mill grinds a bed of cane five feet wide and seven inches thick at the rate of fifteen feet per minute. With the experimental cane the rate was seven feet only per minute, special efforts being made to keep this bed uniform in thickness.

The juice, as it came from the mill, was carefully sampled, measured and analyzed; in this way the quantity of sugar expressed from the cane was accurately determined for each experimental plot. For convenience, the results in every case have been tabulated, as *pounds of sugar in the mill juice from one acre of sorghum.* (See preceding table.)

The total weight of sugar in an acre of cane was also determined in every instance; the losses of sugar in the mill bagasse can therefore be readily calculated.

These losses, it will be seen, vary considerably; the maximum being *fifty-nine per cent.*, and the minimum *forty per cent.* of the total sugar produced by the plant.

These enormous wastes are not due to poorly constructed machinery, for the Rio Grande mill is admitted by experts to be one of the best in operation; nor are they caused by careless management, for an accurate daily record is kept of the mill juice, and constant efforts are made to increase its quantity. The number of gallons of juice secured from a ton of cane appears small; this, in a measure, is due to the method of calculation followed. A ton of unstripped and untopped sorghum of the early orange variety at the beginning of the milling season loses approximately *thirty per cent.* of its weight, by the removal of seed tops, leaves and leaf sheaths; in reality, therefore, a ton contains 1,400 pounds only of material fit for sugar making. Ninety gallons of mill juice from a ton of unstripped and untopped cane is equivalent to 130 gallons if calculated upon thoroughly cleaned stalks. This is the basis upon which such calculations should be made.

A well-built cane mill is properly regarded as a model of mechanical skill and workmanship; regarded, however, as a machine for extracting sugar from sorghum, it must be conceded that it is expensive, wasteful and faulty in principle. This opinion is spreading rapidly, and mills will soon be forced to make room for diffusers.

The disadvantages arising from milling unstripped cane have been recognized by the Rio Grande Sugar Company for two or three years; the expenses, however, of constructing and testing a stripping machine have been estimated higher than the probable benefits resulting from its use. The advantages to be gained by working thoroughly stripped cane have, therefore, been carefully studied during the past season.

The following experiments were made in the sugar house by Superintendent Hughes and the Station's Chemist. The objects were:

1. *To compare mill products from unstripped cane with diffusion products from stripped cane.*
2. *To compare diffusion products from unstripped cane with those from stripped cane.*

The results of the comparison are as follows:

A. With regard to the *quantity* of sugar extracted from sorghum; mill yields from unstripped cane must be increased by 84 per cent., in order to equal diffusion yields from stripped cane.

B. With regard to the *quality* of products; mill juice from unstripped cane is inferior to diffusion juice from stripped cane:

1. In purity, taste and color;
2. In concentration; mill juice from unstripped cane containing less sugar by 18 per cent. than diffusion juice from stripped cane;

C. Diffusion products from unstripped cane are inferior to those from stripped cane.

1. In color, taste and purity;
2. In concentration; stripping cane effects a saving of 33 per cent. in the weight of water to be evaporated.

DESCRIPTION AND DETAILS OF EXPERIMENTS.

I.

To Compare Mill Products from Unstripped Cane with Diffusion Products from Stripped Cane.

In drawing this comparison the following points have been considered:

1. The total amount of sugar in the cane.
2. Losses of sugar caused by milling unstripped sorghum.
3. The diffusion of stripped cane.
4. Losses of sugar in diffusion bagasse.
5. Milling and diffusion compared, with reference to the amounts of sugar separated from the cane.
6. The quality of diffusion products from stripped cane, compared
   (1) With mill products from stripped cane;
   (2) With mill products from unstripped cane.
7. Conclusion.

1.

THE TOTAL AMOUNT OF SUGAR IN THE CANE.

A quantity of early orange sorghum, weighing 26 tons, was divided into 15 portions, from each of which was drawn a weighed sample of approximately 100 pounds.

After each sample had been stripped and topped, it was passed through a Lion cutter and crusher and thoroughly mixed; subsamples of 4 pounds were then taken, dried at 120° Fahr., and preserved for analysis.

The average results from 15 determinations show that one ton of this unstripped and untopped cane contained 145 pounds of sugar.

2.

LOSSES OF SUGAR CAUSED BY MILLING UNSTRIPPED SORGHUM.

The fifteen portions of green cane, of which the smallest exceeded one ton in weight, were topped with a guillotine and slowly ground in an excellent mill. The juice from each portion was carefully measured and sampled.

The average result from fifteen analyses shows that the mill expressed seventy pounds of sugar from each ton of unstripped and untopped cane.

From the one hundred and forty-five pounds of sugar contained in one ton of this sorghum, the mill therefore expressed only seventy pounds, or forty-eight and three-tenths per cent. Consequently more than one-half of the sugar produced by the plant was wasted by the mill bagasse.

3.

DIFFUSION OF STRIPPED CANE.

At Rio Grande there are ten diffusers, each of which has a capacity of seventy-two cubic feet, and consequently can hold forty-five hundred pounds of water.

When in operation each of these cells should be packed with finely-cut sorghum and closed air-tight; water should then be forced in through the bottom of the first cell until it flows from the air cock at the top. In passing through this cell the water takes up a very large portion of the total sugar stored in the cane, but the solution is too dilute to admit of economical working; it is, therefore, slowly forced in succession through the cane in the remaining nine cells, and when finally discharged it should be nearly as concentrated as mill juice.

Water fills the first cell whenever dilute juice is forced into the second, third or following cells; consequently, when the juice flows from the last diffuser, the cane sections in the first will have been extracted ten times with pure water and should then contain traces only of sugar. This extracted cane is called diffusion bagasse and is removed to the compost field. Cell No. 1 is then refilled with fresh sorghum and becomes No. 10 in battery. When the contents of cell No. 2 have been leached ten times with water and dilute juice, this cell is also cleaned and refilled with fresh sorghum. As each following cell in turn is treated in a similar manner the process is made continuous.

4.

EXPERIMENT MADE TO DETERMINE THE AMOUNT OF SUGAR LEFT IN DIFFUSION BAGASSE.

One hour's work with thirty men proved conclusively that with unskilled labor it would cost $9 00 per ton to *completely* remove leaves, including the entire *sheaths*, from selected canes. Diffusion upon a large scale with carefully stripped sorghum was therefore impracticable, and the following trials were made in a hastily-constructed apparatus, which allowed only 160 pounds of cane to be treated in each experiment.

The following tabulation is intended to show the working of diffusion in cell No. 1; a pound of water being used in each charge for every pound of stripped and topped cane:

	Brix.	Temperature	Percentage of sugar in juice.	Pounds of juice discharged to 100 lbs. of cane.	Pounds of sugar from 100 lbs. of cane.
Discharge No. 1	5.2 deg.	14 deg. R.	3.71 p. c.	90.0 lbs.	3.34 lbs.
" " 2	3.4 "	"	2.46 "	90.6 "	2.23 "
" " 3	2.1 "	"	1.51 "	90.6 "	1.37 "
" " 4	1.2 "	"	0.91 "	92.7 "	0.84 "
" " 5	0.8 "	"	0.60 "	91.7 "	0.55 "
" " 6	0.6 "	"	0.52 "	91.7 "	0.48 "
" " 7	0.3 "	"	0.50 "	91.7 "	0.46 "
" " 8	0.2 "	"	0.20 "	93.7 "	0.19 "
" " 9	0.0 "	"	0.12 "	94.8 "	0.12 "
" " 10	0.0 "	"	0.06 "	96.0 "	0.06 "
Total amount of sugar extracted from 100 pounds of cane					9.64 lbs.

The diffusion bagasse, removed after discharge No. 10, was dried and ground to a flour; from this flour boiling alcohol extracted ninety-five one hundredths of one per cent. of sugar, calculated upon the original cane.

The total amount of sugar present before diffusion, was determined in a sub-sample from nearly one hundred and fifty pounds of finely-cut and thoroughly-mixed cane, from which seed tops, leaves and leaf sheaths had been carefully removed. The following balance therefore can be readily drawn:

DIFFUSER No. 1.

	Dr.	Cr.
To sugar contained in 100 pounds of cane..................	10.87 lbs.	....
By " discharged in diffusion bagasse......................	....	0.95 lbs.
" " " " dilute solutions........................	....	9.64 "
" " lost in manipulation........................	....	0.28 "
	10.87 lbs.	10.87 lbs.

Of the total sugar present in this cane 88.7 per cent. was found in the diffusion juice; 8.8 per cent. in the diffusion bagasse and 2.5 per cent. appears to have been lost in manipulation.

A ton of sorghum carrying 145 pounds of sugar will therefore yield 129 pounds to diffusion.

5.

MILLING AND DIFFUSION COMPARED WITH REFERENCE TO THE AMOUNTS OF SUGAR SEPARATED FROM THE CANE.

Under the above conditions, out of 145 pounds of sugar contained in one ton of cane, the mill secures 70 pounds, and the diffusers 129 pounds.

Mill products, therefore, must be increased by 84 *per cent. before they can equal diffusion products.*

6.

THE QUALITY OF DIFFUSION PRODUCTS FROM STRIPPED CANE COMPARED.

(1.) *With mill products from stripped cane.*
(2.) *With mill products from unstripped cane.*

In the above description of a diffusion battery, it was stated that the sugar solutions from the first cell were too dilute to admit of profitable working and that they were therefore passed in succession through ten cells full of cane in order that they might approximate mill juice in concentration.

The following tabulation illustrates the changes which take place as the juice passes from diffuser to diffuser. The cane used was first stripped and topped, then passed through a cutter and crusher and thoroughly mixed. A portion was ground in a hand-mill in order to determine the concentration of mill juice, and a second portion was dried, ground to a flour and extracted with boiling alcohol, in order to determine the total amount of sugar present; this was found to be 10.28 per cent.

In the following trial one and two-tenths pounds of water or juice were used for each pound of cane; it was allowed to act in each diffuser for ten minutes at 140° Fahr.

	Brix.	Temperature.	Percentage of sugar in juice.	Purity.
Diffuser No. 1	4.2 deg.	18 deg. R.	2.93 p c.	69.70 deg.
" " 2	6.6 "	"	4.21 "	63.80 "
" " 3	8.8 "	"	5.84 "	66.30 "
" " 4	10.4 "	"	6.88 "	66.10 "
" " 5	11.9 "	"	7.66 "	64.30 "
" " 6	13.3 "	"	8.92 "	67.10 "
" " 7	14.4 "	"	9.74 "	67.60 "
" " 8	15.2 "	"	10.23 "	67.30 "
" " 9	16.0 "	"	10.87 "	68.00 "
" " 10	17.0 "	"	11.70 "	68.80 "
Mill juice from stripped cane	18.8 deg.	15 deg. R.	11.85 p. c.	63.00 deg.
Mill juice from unstripped cane, average of 15 analyses	15.1 deg.	15 deg. R.	9.88 p. c.	61.20 deg.

THE QUALITY OF DIFFUSION JUICE FROM STRIPPED CANE COMPARED WITH THAT OF MILL JUICE FROM STRIPPED CANE.

The above table indicates that diffusion juice from cell No. 10 contained 11.70 per cent. of sugar, while mill juice from another portion of the same cane contained 11.85 per cent.; in concentration, therefore, these two juices are practically equal. In purity, however, the diffusion juice excelled by nearly six degrees; that is, 100 pounds of solid matter from diffusion juice contained 68.8 pounds of sugar, while 100 pounds of solid matter from mill juice contained but 63 pounds of sugar.

In color, taste and freedom from marked acidity, these juices were practically equal.

THE QUALITY OF DIFFUSION JUICE FROM STRIPPED CANE COMPARED WITH THAT OF MILL JUICE FROM UNSTRIPPED CANE.

At the beginning of this report it was noted that the 26 tons of unstripped and untopped cane, used in the milling experiment, averaged 7.25 per cent. of sugar.

The smaller quantity of cane used in the above diffusion trial contained 7.20 per cent. of sugar, equivalent to 10.28 per cent. if calculated upon stripped and topped weights. A fair comparison can therefore be drawn in regard to the quality of diffusion products from stripped cane, and mill products from unstripped cane.

For convenience of reference, all analyses are included in the above table. It can there be seen that mill juice from unstripped cane is no richer in sugar than diffusion juice from cell No. 7, while in purity it fails to equal it by 6.5 degrees.

In order to equal diffusion juice from cell No. 10, the sugar in the mill juice from unstripped cane must be increased by 18 per cent., and the purity of mill juice must be improved by nearly eight degrees.

7.

CONCLUSIONS.

The conclusions drawn in the comparison of mill products from unstripped cane with diffusion products from stripped cane may be summed up as follows:

A. The quantity of sugar expressed from unstripped cane by milling must be increased by 84 per cent. in order to equal that secured by diffusing stripped cane.

B. The sugar must be increased by nearly 18 per cent., and the purity must be improved by nearly eight degrees before mill juice from unstripped cane can equal diffusion juice from stripped cane. The diffusion juices also excel both in color and taste.

II.

Compare Diffusion Products from Stripped and Unstripped Cane.

In the comparison of diffusion products from stripped and unstripped cane, the following points have been particularly noted:

1. The volume of water to be evaporated in order to secure a definite weight of sugar.
2. The color, purity and taste of the products.

For comparison with the preceding diffusion trial a quantity of topped but unstripped sorghum was selected, which analyzed 8.08 per cent. of sugar, equivalent to 10.65 per cent. if calculated upon a carefully stripped basis.

This cane was cut, crushed, mixed and sub-sampled in the manner already described. In the diffusers it was also treated in the customary manner, as far as temperature and time of digestion were concerned; the relative amount of water used, however, was very much increased.

Stripped sorghum is comparatively dense, a cubic foot weighing 37 pounds; unstripped sorghum is bulky, one cubic foot weighing approximately only 21 pounds. A diffuser of 72 cubic feet capacity would, therefore, hold 2,600 pounds of stripped cane and 1,900 pounds of water. The same diffuser, however, would hold only 1,500 pounds of unstripped cane and 3,000 pounds of water. In the following trial, therefore, 2 pounds of water were used for each pound of unstripped cane.

For convenience of comparison the results obtained by diffusing stripped sorghum are here reprinted. A description of the details of this experiment may be found upon a preceding page.

Diffuser	DIFFUSION OF UNSTRIPPED CANE.				DIFFUSION OF STRIPPED CANE.			
	Brix.	Tempera-ture.	Per Cent. Sugar.	Purity.	Brix.	Tempera-ture.	Per Cent. Sugar.	Purity.
No. 1.....	2.0 deg	16 deg. R.	1.93	96.6	4.2 deg	18 deg. R.	2.93	69.7
" 2.....	3.7 "	16 " "	2.33	63.0	6.6 "	18 " "	4.21	63.8
" 3.....	5.0 "	16 " "	3.14	62.9	8.8 "	18 " "	5.84	66.3
" 4.....	6.6 "	16 " "	4.02	60.9	10.4 "	18 " "	6.88	66.1
" 5.....	8.3 "	16 " "	4.85	58.5	11.9 "	18 " "	7.66	64 3
" 6.....	9.7 "	16 " "	5.63	58.0	13.3 "	18 " "	8.92	67.1
" 7.....	10.4 "	16 " "	6.06	58.2	14.4 "	18 " "	9.74	67.6
" 8.....	11.9 "	16 " "	6 84	57.5	15.2 "	18 " "	10.23	67.3
" 9.....	12.8 "	16 " "	7.35	57.4	16 0 "	18 " "	10.87	68.0
" 10.....	....	....	....	....	17.0 "	18 " "	11.70	68.8
Mill juice	16.7 deg.	15 deg. R.	9.83	58.3	18.8 deg.	15 deg. R.	11.85	63.0

THE VOLUME OF WATER TO BE EVAPORATED IN ORDER TO SECURE A DEFINITE WEIGHT OF SUGAR.

The following calculations are based partly upon facts stated in the above table and partly upon analyses, showing that a ton of unstripped and untopped sorghum contains 145 pounds of sugar, of which 90 per cent. or 130 pounds can be secured by diffusion.

1. The solution from the ninth diffuser, working upon unstripped cane, analyzed 7.35 per cent. It would require 1,769 pounds of such a solution to contain 130 pounds of sugar.

2. The solution from the ninth diffuser, working upon stripped cane, analyzed 10.87 per cent. It would require 1,195 pounds of such a solution to contain 130 pounds of sugar.

In order then to obtain a definite weight of sugar, it follows, that if cane is stripped before it is diffused a saving of nearly 33 per cent. will be effected in the weight of water to be evaporated. On 160 tons of cane, an ordinary day's work at Rio Grande, this saving would amount to nearly 11,000 gallons.

THE PURITY, TASTE AND COLOR OF DIFFUSION PRODUCTS FROM UNSTRIPPED CANE.

The most serious objection to unstripped cane lies in the effect of leaves and leaf sheaths upon the purity, taste and color of diffusion products.

PURITY.

In determining the purity of a solution, its percentage of sugar is divided by its specific gravity, expressed by the Brix hydrometer. The term is therefore used to represent the weight of sugar relative to that of other matter held in solution. When the purity is stated to be 60, it signifies that out of every 100 pounds of material dissolved in water 60 pounds are sugar.

In cultivating, harvesting, milling and all subsequent manipulations, the aim should be to increase the purity of the cane juice; for the higher the purity the larger will be the yield of crystallized sugar.

By referring to the table it is evident, for both mill and diffusion products, that the juice from stripped cane is much purer than that from unstripped cane.

It is also evident, in case of the unstripped cane, that the mill juice is superior to diffusion juice from cell No. 9; also that cell No. 9 contains the most impure juice in the battery.

In case of stripped cane, however, the diffusion juice from cell No. 9 is 5 degrees purer than the mill juice; the average purity of the juice in the last five cells is also higher than that in the first five.

These differences in quality between products from stripped and unstripped cane are due to the leaves and leaf sheaths alone. Direct experiments, both by milling and by diffusion, sustain this opinion. The leaves used were moistened before they were ground; diffusion products came from cell No. 6.

PURITY OF MILL AND DIFFUSION PRODUCTS FROM LEAVES AND LEAF SHEATHS.

	Brix.	Temperature.	Per Cent. Sugar.	Purity.
Mill Products	6 0	16	1.14	19.0
Diffusion Products	3.6	17	0.49	13.6

Out of every 100 pounds of solids, separated from leaves, &c., by diffusion, there are 86 pounds of worse than worthless matter and 14 pounds only of sugar. This fact offers a reasonable explanation for the low yields of crystallized sugar and the relatively high yield of syrup, common in the sorghum industry. There seems to be but one rational way of avoiding this trouble, that is to construct a stripping machine; for all of this injurious matter can be kept out of the sugar house, but cannot be readily removed if allowed to go into solutions.

COLOR AND TASTE OF DIFFUSION PRODUCTS FROM UNSTRIPPED CANE.

It has been already stated that in color, taste and acidity, diffusion juices from stripped cane equal mill juice from stripped cane.

In comparison, diffusion juice from unstripped cane was dark colored, bitter and decidedly acid.

The diffusion juice from the leaves and leaf sheaths was very dark, even when it was drawn from the first diffuser. This color deepened rapidly as the juice grew more and more concentrated; the bitter taste also became intense. A portion of this juice was allowed to stand over night, and the next morning putrefaction was evident.

The fact that juice of low purity gives very poor yields of crystallized sugar and relatively high yields of syrup has been already noted. Sales of syrup are based almost exclusively upon color and taste, a few shades either way having greater influence upon the market price than noticeable variations in percentages of sugar. From a financial standpoint, therefore, the effect of leaves upon the color and taste of syrups is of extreme importance.

This effect has been seen upon a large scale at Rio Grande. During this past season, as already stated, the diffusion battery was operated for twenty-six days upon mill bagasse from unstripped cane; this was done partly to avoid waste of sugar, and partly to test the apparatus and train the workmen.

The juice was skillfully handled and clarified, but, owing to the color and taste due to leaves, the 229 barrels of heavy syrup secured are not worth more than one-half as much as an equal quantity of the standard syrup made at this house from mill juice.

CONCLUSION.

The comparison of diffusion products from stripped and unstripped cane indicates that the financial success of the sorghum sugar industry now depends largely upon the removal of leaves and leaf sheaths.

1. Because their presence in the diffusers increases the amount of water to be evaporated by 33 per cent.

2. Because they impart to diffusion juices a very dark color and intensely bitter taste, the effect of which is to reduce the market value of syrups at least one-half.

IV.

SUMMARY.

When the above conclusions, drawn under the headings II. and III., are studied in connection with the approximately correct reports of expenses and sales, under present working processes, the following general statements seem warrantable:

1. If carefully stripped cane only is used at Rio Grande, the substitution of diffusion for milling will be followed by financial success.

2. If unstripped cane is diffused, financial success will still be problematic.

   (1) Because of evaporation expenses;

   (2) Because of a serious depreciation in the market value of syrups, due to their inferior taste and color.

FODDERS AND FEEDS.

No statistics are available for determining positively either the quantity or the market value of the fodders and feeds consumed by the live stock in this State. The following calculations, however, relating to dairies alone, will give an idea of the magnitude of the interest involved.

The tenth census of the United States credits New Jersey with 152,000 milch cows. It can be demonstrated that these cows require annually not less than *five million* and possibly more than *eight million* dollars worth of food—an amount sufficiently large,

FIRST—*To justify the consideration of methods which should be followed in feeding live stock.*

SECOND—*To warrant the examination of the kind and quality of feeding stuffs offered for sale in this State.*

FEEDING SYSTEMS.

According to Professor Julius Kühn, of Halle, Germany, the earliest attempts to develop a rational feeding system consisted in drawing comparisons between different fodders and feeds.

Hay was taken as the standard, and 100 pounds of it were regarded as equal in feeding value to 200 pounds of oat straw, or to 300 pounds of rye straw, or to 350 pounds of fodder beets, or to 40 pounds of oil meal.

Thirty years ago it was believed that to support life without loss of flesh a cow should be fed daily one-fiftieth of its weight of hay, or an equivalent in other fodder, and that for every pound of hay or its equivalent eaten in excess of that amount, either one pound of milk or one-tenth of a pound of flesh should be produced. To support life, therefore, this system claimed that a cow weighing *one thousand pounds* should be fed daily either 20 pounds of hay, or

40 pounds of oat straw, or 60 pounds of rye straw, or combinations of fodders and feeds equivalent to 20 pounds of hay, but to produce 20 pounds of milk daily the same cow should receive 40 pounds of hay, or 80 pounds of straw, or an equivalent amount of mixed food.

One of the greatest drawbacks to this system was the fact that no two authorities agreed as to the value of the different fodders. Such differences, however, are now easily explained, for it is known that the composition of hay, and of all other farm crops, varies with soils, climate, date of harvesting, method of curing, etc.; while feeding values of fodders are noticeably influenced by the manner in which rations are mixed and balanced. As both the quality of feeds and method in mixing were ignored at that time, any agreement between investigators must have been purely accidental.

Dr. Haubner, of the Eldena Experiment Station, was among the first to advance towards a more rational system. While experimenting about the year 1850, he found that sheep would eat approximately 3 pounds of rye straw and 3 pounds of potatoes daily per head. These sheep remained, however, in poor condition, and undigested starch could be easily detected in their manure. When a quarter of a pound of pea meal, or a half a pound of clover hay, or an ounce or two of oil meal was fed to each, in addition to the straw and potatoes, the sheep fattened rapidly, and all traces of starch disappeared from their manure; it immediately appeared again, however, when the hay or meal was withheld from the ration.

Oil meal, pea meal and clover hay contain high percentages of proteine, while straw and potatoes are characterized by very large quantities of starch.

Haubner, therefore, by proving that animals require certain relative amounts of both proteine and starch, forcibly directed attention towards the chemical composition of fodders and feeds.

Several years later Henneberg and Stohmann published the results of their work, which indirectly confirmed Haubner's experiments, and founded the feeding system at present universally recognized.

These chemists proved that in order to prevent either a gain or a loss of live weight, oxen weighing 1,000 pounds, even when idle, should be fed 19 pounds of clover hay daily. They found, too, that quite as good results were secured by using either of the following rations:

No. 1. 12.6 pounds oat straw, 25.6 pounds fodder beets and 1 pound of oil meal.

No. 2. 13 pounds oat straw, 3.7 pounds clover hay and 0.6 pound of oil meal.

No. 3. 14.2 pounds oat straw, 2.6 pounds clover hay and 0.5 pound of oil meal.

No. 4. 13.3 pounds rye straw, 3.8 pounds clover hay and 0.6 pound of oil meal.

As already stated, in their effect upon oxen, these four rations were identical, and gave the same results as 19 pounds of clover hay.

The theories of that day demanded of such rations that the sum of their different materials, reduced to the hay standard, should equal one-fiftieth of the live weight of the animals which they supported.

The following results were obtained by subjecting the above rations to this test:

Ration No. 1.	Ration No. 2.	Ration No. 3.	Ration No. 4.
12.5 lbs. Oat Straw equals 6.3 lbs. Hay.	13.0 lbs. Oat Straw equals 6.5 lbs. Hay.	14.2 lbs. Oat Straw equals 7.1 lbs. Hay.	13.3 lbs. Rye Straw equals 4.4 lbs. Hay.
25.6 lbs. Fodder Beets equals 9.0 lbs. Hay.	3.7 lbs. Clover Hay equals 3.7 lbs. Hay.	2.6 lbs. Clover Hay equals 2.6 lbs. Hay.	3.8 lbs. Clover Hay equals 3.8 lbs. Hay.
1.0 lbs. Oil Meal equals 2.5 lbs. Hay.	0.6 lbs. Oil Meal equals 1.5 lbs. Hay.	0.5 lbs. Oil Meal equals 1.25 lbs. Hay.	0.6 lbs. Oil Meal equals 1.5 lbs. Hay.
Ration No. 1 equals 17.8 lbs. Hay.	Ration No. 2 equals 11.7 lbs. Hay.	Ration No. 3 equals 10.95 lbs. Hay.	Ration No. 4 equals 9.7 lbs. Hay.

Theoretically, ration No. 1 should support an animal weighing nearly 900 pounds (17.8x50), while ration No. 4 should not support one weighing over 500 pounds (9.7x50); practically, however, they each, upon trial, supported oxen of 1,000 pounds live-weight, proving that either the theory was false or that the table of equivalents in use was unreliable. An attempt to establish a more trustworthy schedule from the above experimental data also resulted in absurdities. Henneberg and Stohmann therefore abandoned this theory and devoted themselves to the study of the chemical composition and digestibility of fodders and feeds.

In this they were successful, for by analyzing the food consumed and subtracting from it the amount of undigested matter found in the excrement, the following results were secured from oxen weighing 1,000 pounds each:

DIGESTIBLE FOOD NEEDED FOR THE DAILY SUPPORT OF A 1,000 POUND OX.

	19 lbs. of Clover Hay.	Ration No. 3.	Ration No. 4.
Digestible Proteine	0.84 lbs.	0.41 lbs.	0.49 lbs.
Digestible Starchy Matter	7.72 lbs.	8.16 lbs.	8.15 lbs.

Practically, these three rations agree that *eight pounds* of digestible starch or similar compounds are necessary to prevent loss of live-weight in unworked oxen; regarding the amount of proteine needed in addition to the starch, ration No. 3 proves that 0.41 pounds is sufficient; it proves further, when compared with the other rations, that if an animal is fed upon clover hay alone, in order to secure the starch needed, it must waste proteine enough to support another animal of its own size. Chemistry, therefore, is the basis of the feeding system introduced by Henneberg and Stohmann.

During the past twenty-five years analyses have been made of all known feeding stuffs, from which it has been learned—

I. That some materials are sources principally of proteine, while others supply fat and carbhydrates (starchy matter) in excess. To a certain extent these analyses have also shown the influence exerted by soils, climate, time of harvest, method of curing, &c., upon the quality of the product.

II. It has also been shown that animals do not digest all of the proteine, fat or carbhydrate eaten, even under most favorable circumstances; the quantities wasted being noticeably influenced by the relative amounts of these three elements present in the ration, as well as by the mechanical condition of the fodder or feeds.

III. It has been definitely settled that all elements necessary to sustain life, or to produce meat and milk, can be included in the classes *proteine, fat, carbhydrates* and *ash.*

IV. The limits have been fixed which define the amounts of proteine, fat and carbhydrates which should be fed daily, either for fattening, for breeding, for labor or for milk production. In this work due regard has been paid to the cost of the feed used and to the market value of the product gained; for example, careful trials have often demonstrated that a cow of 1,000 pounds live-weight in full flow of milk should be fed daily from—

2.00 to 2.75 pounds of digestible Proteine.
0.40 to 0.75 pounds of digestible Fat.
12.50 to 15.00 pounds of digestible Carbhydrates.

When milk or its products command high prices, and when fodders and feeds can be bought at reasonable rates, the maximum amounts of proteine, &c., may be profitably fed to a first-class milch cow. Under ordinary conditions, however, larger profits will be secured from approximately 2½ pounds of proteine, four-tenths of a pound of fat and 12½ pounds of carbhydrates.

Briefly, therefore, *Henneberg and Stohmann's system regards fodders and feeds as sources of proteine, fat, carbhydrates and ash. It also shows the number of pounds of digestible proteine, &c., which should be fed daily, in order to secure the most profitable returns in meat, milk and labor.*

THE PRACTICAL USE WHICH NEW JERSEY FARMERS SHOULD MAKE OF THIS SYSTEM.

In this State there are many farms of 100 acres, upon which it seems desirable to herd from 30 to 40 milch cows. Upon such farms 12 acres are usually planted in field corn, 12 acres sown in oats and 12 in wheat, 36 acres are kept in meadow, approximately 5 acres are used as a pasture or exercising place and the rest of the land is either cultivated in fodder corn, rye, potatoes, &c., or is occupied by farm buildings and roads.

The problem is to use profitably, upon the farm, all of the coarse, low-priced fodder which it produces. After a favorable season there should be available approximately 24 tons of field corn stalks, 12 tons of wheat straw and 8½ tons of oat straw. The analyses of this fodder indicate the following amounts of digestible food:

DIGESTIBLE FOOD IN CORN STALKS, OAT AND WHEAT STRAW.

	Digestible Fat.	Digestible Proteine.	Digestible Carbhydrates, including Fiber.
24 tons of Field Corn Stalks contain	410 lbs.	1,440 lbs.	21,837 lbs.
12 " " Wheat Straw "	124 lbs.	122 lbs.	9,196 lbs.
8.5 " " Oat Straw "	101 lbs.	255 lbs.	6,570 lbs.
Totals	635 lbs.	1,817 lbs.	37,603 lbs.

The quantity of proteine, &c., which can be profitably fed daily to a milch cow has been already stated. Upon this basis a herd of forty cows would require each day approximately—

Digestible Proteine.	Digestible Fat.	Digestible Carbhydrates.
100 lbs.	20 lbs.	500 lbs.

The stalks and straw, therefore, according to the above table, contain carbhydrates enough to support this herd for *seventy-five days*, while they contain fat enough for 30 days and proteine for 18 days only. In order, then, to utilize the carbhydrates, the following quantities of proteine and fat must be secured from other sources—

	Proteine.	Fat.	Carbhydrates.
Forty cows require for 75 days' food....................	7,500 lbs.	1,500 lbs.	37,500 lbs.
The Corn Stalks and Straw contain....................	1,817 "	635 "	37,603 "
To be secured from other sources.................	5,683 lbs.	865 lbs.	....

There are no well-known feeds which are entirely free from carbhydrates; in order, therefore, to secure the proteine and fat needed, a certain amount of starchy matter must at the same time be purchased and used. In selecting concentrated feeds, therefore, with which to utilize coarse fodders, choice should be made of those which furnish the largest amounts of digestible proteine for the least money. As the market now stands, brewers' grains, cotton seed meal, bran and new process linseed meal fulfill these conditions.

If the stalks are shredded and the straw is cut as fine as necessary, the following rations will be found profitable. The calculations are intended to represent the amounts of digestible food which should be fed daily to a cow weighing *one thousand pounds:*

BREWERS' GRAINS RATION.

TABLE NO. 1.

	Digestible Proteine.	Digestible Fat.	Digestible Carbhydrates.
20 pounds of Brewers' Grains..........................	1.20	0.32	3.20
3 " " Linseed Meal.......................... ..	0.90	0.10	1.12
10.8 " " Shredded Corn Stalks....................	0 32	0.09	4.91
5.4 " " Wheat Straw................................	0.03	0.02	2.07
3.8 " " Oat Straw..................................	0.06	0.02	1.47
Amount of food needed daily for one cow...........	2.51	0.55	12.77
Amount of food needed daily for forty cows........	100 lbs.	22 lbs.	511 lbs.

Assuming that 24 tons of corn stalks are available, then 10.8 pounds : 3 pounds as 24 tons : 6.7 tons, the number of tons of linseed meal needed to utilize the corn stalks, according to the above ration.

The following table was calculated by this rule—

TABLE NO. 2.

	Digestible Proteine	Digestible Fat.	Digestible Carbhydrates.
24 tons of Field Corn Stalks contain	1,440 lbs.	410 lbs.	21,837 lbs.
12 " " Wheat Straw "	122 "	124 "	9,196 "
8.5 " " Oat " "	255 "	101 "	6,570 "
45.0 " " Brewers' Grains "	5,400 "	1,413 "	14,607 "
6.7 " " Linseed Meal, new process, contain	4,027 "	434 "	5,010 "
Total food present in above fodders and feeds	11,244 lbs.	2,482 lbs.	57,220 lbs.
Sufficient to support a herd of 40 cows for	112 days.	112 days.	112 days.

By dividing the total amounts of proteine, fat and carbhydrates in table 2 by the amount of each needed for the daily support of 40 cows, table 1, it becomes evident that the above supply is sufficient for *one hundred and twelve days'* consumption.

It has been already shown that the fodder, produced upon 36 acres of corn, wheat and oats, contains *carbhydrates* enough to support 40 cows for 75 days; consequently, *forty-five tons* of brewers' grains and *six and seven-tenths* tons of linseed meal must supply *carbhydrates* for 37 days' use. These weights of linseed meal and brewers' grains also furnish the proteine for 94 days and the fat for 82 days, the fodders furnishing, as already stated, proteine for 18 days and fat for 30 days.

This ration can be used to advantage during the months of December, January, February and March for a number of reasons, one in particular being that numerous opportunities can be found at this season for cutting and shredding straw and stalks. One or two days' profitable work in each week can thus be secured from horses and men otherwise only partially employed.

Forty grade cows in fair milking condition will doubtless average 320 quarts of milk daily if fed upon the above rations. The following balance is based upon this assumption:

HERD OF FORTY COWS.

Cr.

By 320 quarts milk, daily, for 112 days	35,840 quarts.	
Total value of milk, at 4½ cents per quart		$1,612 80

Dr.

To 45.00 tons of brewers' grains, at $3	$135 00	
" 6.7 tons of linseed meal, at $30	201 00	
" Labor, 3 men; depreciation in value of herd; death-rate; interest, &c., at $4.85 daily	543 20	
" Freight to New York, ½ cent per quart of milk	179 20	
	$1,058 40	
Value to the farm of stalks and straw from 36 acres	**554 40**	
		$1,612 80

If it is impossible to secure brewers' grains or if a prejudice is felt against their use, cotton seed meal may be substituted. The ration will then stand as follows: (As already stated these rations are calculated for 1,000 pound cows in full flow of milk.)

	Digestible Protaine.	Digestible Fat.	Digestible Carbhydrates.
14.8 pounds of Shredded Corn Stalks........	0.44 lbs.	0.13 lbs.	6.72 lbs.
7.4 pounds of Wheat Straw....................	0.04 "	0.03 "	2.83 "
5.2 pounds of Oat Straw.......................	0.09 "	0.03 "	2.02 "
5.1 pounds of Cotton Seed Meal.............	1.89 "	0.46 "	1.33 "
Amount of food needed daily for one cow...	2.46 lbs.	0.65 lbs.	12.90 lbs.
Amount of food needed daily for forty cows	98 lbs.	26 lbs.	516 lbs.

The number of tons of cotton seed meal needed to economically utilize the available stalks and straw can be learned by a simple calculation already illustrated upon a preceding page. The results are as follows:

QUANTITY OF COTTON SEED MEAL NEEDED TO UTILIZE THE STALKS AND STRAW FROM TWENTY-FOUR ACRES.

	Digestible Protaine.	Digestible Fat.	Digestible Carbhydrates.
24 tons of Field Corn Stalks contain.........	1,440 lbs.	410 lbs.	21,837 lbs.
12 tons of Wheat Straw contain..............	122 "	124 "	9,196 "
8.5 tons of Oat Straw contain................	255 "	101 "	6,570 "
8.25 tons of Cotton Seed Meal contain......	6,114 "	1,488 "	4,302 "
Total food contained in above fodders and feeds....................................	7,931 lbs.	2,123 lbs.	41,905 lbs.
Sufficient to support a herd of forty cows for	81 days.	81 days.	81 days.

With this ration the cash balance would be as follows:

HERD OF FORTY COWS.

Cr.

By 320 quarts of milk, daily, for 81 days	25,920 quarts.	
Total value of milk, at 4½ cents per quart		$1,166 40

Dr.

To 8.25 tons of cotton seed meal, at $30	$247 50	
" Labor, 3 men; depreciation in value of herd; death-rate and interest account, $4.85 per day	392 85	
" Freight to New York, ½ cent per quart of milk	129 60	
	$769 95	
Value to the farm of stalks and straw from 36 acres	**396 45**	
		$1,166 40

When wheat bran and linseed meal are preferred to either brewers' grains or cotton seed meal, the ration will be as follows:

WHEAT BRAN AND LINSEED MEAL RATION.

	Digestible Protein.	Digestible Fat.	Digestible Carbhydrates.
9.0 pounds of Wheat Bran	1.26 lbs.	0.31 lbs.	4.02 lbs.
3.0 " " Linseed Meal	0.90 "	0.10 "	1.12 "
9.75 " " Shredded Corn Stalks	0.30 "	0.08 "	4.52 "
5.0 " " Wheat Straw	0.03 "	0.02 "	1.87 "
3.25 " " Oat Straw	0.05 "	0.02 "	1.32 "
Amount of food needed daily for one cow	2.54 lbs.	0.53 lbs.	12.85 lbs.
Amount of food needed daily for forty cows	101 lbs.	21 lbs.	514 lbs.

QUANTITIES OF BRAN AND LINSEED MEAL NEEDED IN ORDER TO UTILIZE THE STALKS AND STRAW FROM THIRTY-SIX ACRES.

	Digestible Proteine.	Digestible Fat.	Digestible Carbhydrates.
24 tons of Field Corn Stalks contain..................	1,440 lbs.	410 lbs.	21,837 lbs.
12 " " Wheat Straw "	122 "	124 "	9,196 "
8.5 " " Oat Straw "	255 "	101 "	6,570 "
20 " " Wheat Bran "	5,608 "	1,360 "	17,908 "
7.2 " " Linseed Meal, new process, contain......	4,508 "	487 "	5,625 "
Total food present in above fodders and feeds..	11,933 lbs.	2,482 lbs.	61,136 lbs.
Sufficient to support a herd of forty cows for...	118 days.	118 days.	118 days.

HERD OF FORTY COWS.

Cr.

By 320 quarts of milk, daily, for 118 days........................ 37,760 quarts.		
Total value of milk at 4½ cents per quart..		$1,699 20

Dr.

To 20 tons bran at $19 per ton...	$380 00	
" 7.2 " linseed meal at $30 per ton.................................	216 00	
" Labor, 3 men; depreciation in value of herd; death-rate and insurance, $4.85 per day..	572 30	
" Freight to New York, ½ cent per quart on 37,760 quarts....	188 80	
	$1,357 10	
Value to the farm of stalks and straw from 36 acres..	**342 10**	
		$1,699 20

The rations mentioned thus far provide for the consumption of all the straw produced upon the farm; to this objections have been raised by some of the older farmers, who claim that under such management nothing would be left for bedding and absorbents.

There is also in many minds a decided prejudice in favor of corn meal for dairy food. A ration has therefore been calculated from which wheat straw has been omitted and into which corn meal has been introduced :

CORN MEAL RATION.

	Digestible Proteine.	Digestible Fat.	Digestible Carbhydrates.
8 pounds of Corn Meal...........................	0.55 lbs.	0.27 lbs.	5.00 lbs.
5½ pounds of Linseed Meal......................	1.58 "	0 16 "	1.94 "
9¾ pounds of Shredded Corn Stalks...........	0.30 "	0.08 "	4.52 "
3½ pounds of Oat Straw..........................	0.05 "	0.02 "	1.32 "
Amount of food needed daily for one cow...	2.48 lbs.	0.53 lbs.	12.78 lbs.
Amount of food needed daily for forty cows	99 lbs.	21 lbs.	511 lbs.

QUANTITIES OF CORN MEAL AND LINSEED MEAL NEEDED IN ORDER TO UTILIZE THE STALKS AND STRAW FROM TWENTY-FOUR ACRES.

	Digestible Proteine.	Digestible Fat.	Digestible Carbhydrates.
24 tons of Shredded Corn Stalks	1,440 lbs.	410 lbs.	21,837 lbs.
8.25 tons of Oat Straw	247 "	98 "	6,373 "
19.7 tons of Corn Meal	2,758 "	1,327 "	24,625 "
12.9 tons of Linseed Meal	7,740 "	774 "	9,791 "
Total digestible food in above fodders and feeds	12,185 lbs.	2,609 lbs.	62,626 lbs.
Sufficient to support a herd of forty cows for	123 days.	123 days.	123 days.

HERD OF FORTY COWS.

Cr.

By 320 quarts of milk, daily, for 123 days	39,360 quarts.	
Total value of 39,360 quarts of milk, at 4½ cents		$1,771 20

Dr.

To 19.7 tons corn meal, at $18	$354 60	
" 12.9 tons linseed meal, at $30	387 00	
" Labor, 3 men; depreciation in herd value; death-rate, interest, &c., $4.85 daily	596 55	
" Freight to New York, ½ cent per quart	196 80	
	$1,534 95	
Value to the farm of stalks and straw	**236 25**	
		$1,771 20

These four rations contain, practically, the same amounts of digestible food, and, under similar conditions, are each of equal value for milk production.

This feeding system, therefore, indicates how fodders and certain waste materials from manufactories may be mixed and used in dairies to displace hay and corn meal—two products which can generally be sold, in the form in which they are harvested, for as much or for more than they are worth after they have been converted into milk and meat.

This system also makes it possible to decide which of the concentrated feeds can be purchased and used with most profit. Of course, such profits depend largely upon the cash balance from the milk account, already noted under each of the above rations, but they are also influenced by the quality of the manure from a herd.

Proteine is a complex compound, one-sixth of its weight being nitrogen. When eaten by animals, the undigested proteine carries its nitrogen, unchanged in form, direct into the solid excrement; the nitrogen of the digested proteine passes from the animal either in its milk or in its urine.

The above rations are intended for milk production, and it is not expected that their use will be followed either by an increase or by a loss of live-weight, consequently the errors will be small if the quantities of nitrogen, phosphoric acid and potash sold in the milk are subtracted from the quantities found in the feed, and the differences charged to the farm at the prices which nitrogen, phosphoric acid and potash command when in the form of barn-yard manure. At *two dollars* per ton of manure, these prices will approximate *ten cents* per pound of nitrogen, *five cents* per pound of phosphoric acid, and *four and a quarter cents* per pound of potash. Upon this basis the manurial value of the feed used in each ration will be as follows:

COTTON SEED MEAL RATION.

	Nitrogen.	Phosphoric Acid.	Potash.
8.4 tons Cotton Seed Meal contain	1,176 lbs.	583 lbs.	323 lbs.
25,920 quarts of milk	156 "	65 "	42 "
Nitrogen, Phosphoric Acid and Potash from feeds to be charged to manure	1,020 "	518 "	281 "
	10c. per lb.	5c. per lb.	4¼c. per lb.
Value of the Nitrogen, Phosphoric Acid and Potash from feeds to be charged to the manure	**$102.00**	**$25.90**	**$11.94**
Total manurial value of the feeds			**$139.84**

WHEAT BRAN RATION.

	Nitrogen.	Phosphoric Acid.	Potash.
20 tons of Wheat Bran contain..	988 lbs.	1,054 lbs.	580 lbs.
7.2 tons of Linseed Meal contain..	821 "	320 "	229 "
Total amounts of Nitrogen, Phosphoric Acid and Potash found in above feeds..	1,809 "	1,374 "	809 "
37,760 quarts of milk contain..	227 "	94 "	60 "
Weights—Nitrogen, Phosphoric Acid and Potash from feeds to be charged to the manure..................................	1,582 "	1,280 "	749 "
	10c. per lb.	5c. per lb.	4¼c. per lb.
Value of the Nitrogen, Phosphoric Acid and Potash from feeds to be charged to the manure.....	**$158.20**	**$64.00**	**$31.83**

Total manurial value of the feeds... $254.03

CORN MEAL RATION.

	Nitrogen.	Phosphoric Acid.	Potash.
19.7 tons of Corn Meal contain.....	571 lbs.	244 lbs.	162 lbs.
12.9 tons of Linseed Meal contain..	1,478 "	573 "	410 "
Total amounts of Nitrogen, Phosphoric Acid and Potash found in the above feeds..	2,044 "	817 "	572 "
39,360 quarts of milk contain.........	236 "	98 "	63 "
Amounts of Nitrogen, Phosphoric Acid and Potash from feeds to be charged to the manure..................................	1,808 "	719 "	509 "
	10c. per lb.	5c. per lb.	4¼c. per lb.
Value of the Nitrogen, Phosphoric Acid and Potash from feeds to be charged to the manure.....	**$180.80**	**$35.95**	**$21.63**

Total manurial value of the feeds...... .... $238.38

BREWERS' GRAINS RATION.

	Nitrogen.	Phosphoric Acid.	Potash.
45 tons of Brewers' Grains contain	999 lbs.	279 lbs.	45 lbs.
6.7 tons of Linseed Meal contain	765 "	297 "	213 "
Total amounts of Nitrogen, Phosphoric Acid and Potash found in the above feeds	1,764 "	576 "	258 "
35,840 quarts of milk contain	215 "	90 "	57 "
Amounts of Nitrogen, Phosphoric Acid and Potash from feeds to be charged to the manure	1,549 "	486 "	201 "
	10c. per lb.	5c. per lb.	4¼c. per lb.
Value of Nitrogen, Phosphoric Acid and Potash from feeds to be charged to the manure	**$154.90**	**$24.30**	**$8.54**

Total manurial value of the feeds............ $187.74

After all proper charges and credits have been entered against each ration, the final balances will be as follows:

	Length of Period.	Balance from Milk Account.	Balance from Manure Account.	Total Balance.
Brewers' Grains ration	112 days.	$554 40	$187 74	$742 14
Cotton Seed Meal ration	81 "	396 45	139 84	536 29
Wheat Bran ration	118 "	342 10	254 03	596 13
Corn Meal ration	123 "	236 25	238 38	474 63

These balances represent the amounts which must cover the profits on the herd for the above periods, as well as the cost of 24 tons of corn stalks, 12 tons of wheat straw and 8½ tons of oat straw.

From these calculations it appears that, under the above conditions, coarse fodders can be most profitably utilized when fed with brewers' grains and linseed meal, mixed in proper proportions. This is particularly true for farms upon which a year's supply of grains can be stored in May or June, when the price is approximately *three dollars* per ton or *six cents* per bushel; if calculated at *twelve cents* per bushel, an ordinary price for small quantities during the winter, the balance would be at once reduced from $742 to $607, at which grains can hardly be regarded as preferable to good wheat bran.

Upon farms with small herds and relatively large areas in corn and grain, cotton seed meal can be used with marked profit. During the period covered by this ration, eighty-one days, the calculated daily balance is *six dollars and sixty-two cents,* identical with that from the brewers' grains ration; if, therefore, the supply of stalks and straw is sufficient to last as long as fodder of this kind should be fed, cotton seed meal at *thirty dollars* per ton is preferable to grains at three dollars per ton, no silos or similar expensive arrangements being required.

The above system, if strictly followed in a dairy, would necessitate a thorough chemical analysis of every fresh supply of feed or fodder purchased, thereby involving expenses greater than dairymen would consider warrantable. It is not expected, however, that this system can take the place of either experience or good judgment; it is claimed to be simply a guide, to be followed only as far as it is known to be trustworthy. For this purpose the quantity of digestible proteine, fat and carbhydrates present in a given supply of feed need not be determined within an ounce, a knowledge of the approximately correct amounts being all that is necessary.

An experienced farmer quickly decides from the general appearance of a feed, or from his knowledge of the conditions under which a fodder has been grown and cured, whether its condition is good, medium or poor. If chemists would classify their samples, for instance, of corn meal, and publish in tabular form the average analyses of its good, medium and poor grades, the information necessary for the introduction of this system would soon be available. The experience and judgment of a farmer would still be requisite in grading his feeding stuffs; after this had been done reference to a table would give their composition with sufficient accuracy for ordinary purposes.

In Germany, tables giving the composition of feeds and their digestibility are in every-day use, and are recognized as thoroughly serviceable. Efforts are now being made to prepare similar tables for the United States, the officials of the Connecticut Station in particular having been steadily at work for a number of years with this aim in view. Several of the other stations are also busily engaged in analyzing the fodders and feeds consumed in their States, and it is expected, therefore, that a very large amount of valuable material will soon be ready for practical use.

During the past year considerable attention has been paid to the feeds offered for sale in New Jersey. The aim has been to determine—

1. The kinds of feeding stuffs in general use.
2. The limits within which a given article, corn or oil meal for instance, can reasonably be expected to vary in composition.

THE KINDS OF FEEDING STUFFS IN GENERAL USE IN NEW JERSEY.

One hundred and eighteen samples of feeds were analyzed in this Station's laboratory during November and December, 1885. Of these twenty-one were secured by the Director, but all of the others were drawn by the following gentlemen, in response to direct requests:

James Neilson	New Brunswick	Middlesex county.
L. T. Derousse	Camden	Camden county.
Taylor Bros	Camden	Camden county.
J. J. Mitchell	Whippany	Morris county.
Omar Borton	Woodstown	Salem county.
William S Vanderhuff	Deckertown	Sussex county.
H. I. Budd	Mount Holly	Burlington county.

The samples represent fifteen different kinds of feed; the list is as follows:

	Samples.		Samples.
Corn meal	25	Flax seed meal	2
Wheat bran	18	Cotton seed meal	2
Wheat middlings	17	Pea feed	2
Mixed feed	13	Hominy meal	1
Ground rye and rye bran	12	Corn bran	1
Buckwheat bran	8	Malt sprouts	1
Oats	8	Broom corn seed	1
Oil meal	7		
		Total	118

The description of each sample, the county in which it was drawn, the date of the inspection and the price per ton of feed upon that date, can be found in the following tables. These tables give the percentages of proteine, fat, carbhydrates including fiber and ash—this data being necessary for computing feeding values; they also give the percentages of nitrogen, phosphòric acid and potash, from which the manurial value of each feed can be estimated.

Analytical Methods.

The determination of *moisture* in all cases was made by heating the sample, at 100° C., in a current of hydrogen gas until constant weights were secured. *Crude fat* represents the material which water-free ether extracts from thoroughly dried fodder; this extracted matter was also heated at 100° C., in a current of hydrogen until no further losses in weight were observed. The term *crude proteine* is used to indicate the product secured by multiplying the percentage of nitrogen found in a feed or fodder by the factor 6.25; and *crude ash* signifies the dried residue secured by charring a feeding stuff, extracting it with water, thoroughly burning the char, adding to the ash the above-mentioned aqueous extracts and evaporating to dryness.

THE LIMITS WITHIN WHICH FODDERS AND FEEDS VARY IN COMPOSITION.

Of the 15 different kinds of feeds tabulated above, 5 are unchanged farm products, and 10 are waste materials from flouring mills, oil works, breweries, etc.

Moisture is the most frequent cause of variations in the quality of farm products. The corn meal table upon a following page illustrates this point. With old, well-cured stock, the losses by drying at 212° Fahr. range from *nine and one-half* to *thirteen and one-half per cent.*, while with new corn the range is from *eighteen and one-third* to *twenty-one per cent.* As the moisture decreases the percentages of proteine, fat, etc., correspondingly increase, so that the variations at times may be very marked. As that table, however, shows, samples can be so classified that the average analyses are fairly representative.

In case of the waste materials from flouring mills, oil mills, etc., the variations in quality are due to a limited extent only to differences in percentages of water.

In linseed mills, for instance, the aim is to remove and utilize as much oil as possible. By the old process the waste amounts to from 7 to 8 per cent. of the press cake, while by the new process this loss amounts to less than *three per cent.*

For several purposes the new process meal is preferable to the old, a decrease in the amount of oil being accompanied by an increase in the amount of proteine, a product which is particularly sought when this meal is purchased for use with coarse fodders. From this standpoint, the more thoroughly the oil men attend to their interest the better their waste product will become for many dairymen.

The variations, therefore, in the quality of waste materials are due principally to the processes followed in producing them. As already stated, however, in case of the corn meal, these products can be so classified that their average analyses are also fairly representative.

These classified averages in the following tables have been collected and compared with similar averages drawn by Prof. Kuhn, of Halle, Germany, and by Dr. Jenkins, of the Connecticut Experiment Station.

These comparisons have been tabulated upon pages 174 to 176 of this report.

CORN MEAL.

Station number.	BRAND.	POUNDS PER HUNDRED OF Water.	Crude Fat.	Crude Ash.	Crude Proteine.	Carbohydrates, including Fiber.	PERCENTAGE OF Nitrogen.	Phosphoric Acid.	Potash.
212	Pure Corn Meal	11.75	4.53	1.40	9.00	73.32	1.44	0.62	0.42
214	Cracked Corn	12.25	3.91	1.27	8.63	73.94	1.38	0.54	0.39
216	Corn Meal	13.51	3.62	1.40	9.06	72.41	1.45	0.60	0.42
217	" "	13.01	3.89	1.42	8.75	72.93	1.40	0.66	0.41
290	" "	13.57	4.55	1.36	9.38	71.14	1.50	0.64	0.39
268	White Dent Corn Meal	12.97	4.35	1.45	9.44	71.79	1.51	0.70	0.48
269	Corn Meal, 8-Rowed, Yellow	12.52	3.75	1.30	9.37	73.06	1.50	0.57	0.37
	Average	**12.79**	**4.08**	**1.37**	**9.09**	**72.65**	**1.45**	**0.62**	**0.41**
282	Yellow Flint Corn Meal	12.36	4.29	1.30	9.13	72.92	1.46	0.56	0.39
302	" " " "	9.58	4.82	1.70	10.44	73.46	1.67	0.75	0.44
274	" " " "	13.05	4.75	1.47	9.56	71.17	1.53	0.75	0.42
	Average	**11.66**	**4.62**	**1.49**	**9.71**	**72.52**	**1.55**	**0.68**	**0.42**
278	White Flint Corn	12.78	4.37	1.58	10.16	71,11	1.63	0.71	0.39
306	" " " Meal	10.29	3.09	1.21	8.88	76.53	1.42	0.58	0.34
	Average	**11.53**	**3.73**	**1.39**	**9.52**	**73.82**	**1.52**	**0.64**	**0.36**
228	Yellow Dent Corn Meal	13.11	4.65	1.12	8.75	72.37	1.40	0.51	0.32
296	" " " "	13.93	3.18	1.36	8.56	72.97	1.37	0.55	0.35
	Average	**13.52**	**3.92**	**1.24**	**8.65**	**72.67**	**1.39**	**0.53**	**0.33**
205	Western Corn Meal, Coarse	12.79	3.95	1.49	8.31	73.46	1.33	0.56	0.39
256	" " " "	11.79	4.11	1.53	9.56	73.01	1.53	0.72	0.44
247	" " " "	12.04	4.00	1.58	8.94	73.44	1.43	0.65	0.43
	Average	**12.20**	**4.02**	**1.53**	**8.97**	**73.30**	**1.43**	**0.64**	**0.42**
324	Corn Meal, Old and New Mixed	16.95	3.72	1.41	8.50	69.42	1.37	0.58	0.36
326	" " " " " "	14.93	4.22	1.46	9.41	69.93	1.51	0.66	0.39
	Average	**15.94**	**3.97**	**1.43**	**8.97**	**69.68**	**1.44**	**0.62**	**0.37**
285	Cracked Corn, New	18.34	4.25	1.46	8.75	67.20	1.40	0.66	0.46
284	New Feed, Indian	20.90	1.96	1.37	8.38	67.39	1.34	0.62	0.37
	Average	**19.62**	**3.17**	**1.42**	**8.57**	**67.30**	**1.37**	**0.64**	**0.41**
251	Corn and Cob Meal, White Flint	12.95	2.19	1.48	7.63	75.75	1.22	0.57	0.43
270	White & Yellow Corn Meal with Cob	11.95	2.88	1.33	6.69	77.15	1.07	0.52	0.49
325	New Corn Cob Meal	21.22	1.88	1.26	7.79	65.35	1.23	0.52	0.39
282	Cob Meal	35.15	1.74	1.27	5.50	56.34	0.88	0.44	0.43

CORN MEAL.

Station number.	BRAND.	COUNTY.	SAMPLED BY	Date of Sampling.	Price per Ton.
212	Pure Corn Meal	Middlesex	Director of Station	Oct. 12, '85.	$24 00
214	Cracked Corn	"	" " "	" "	24 00
216	Corn Meal	"	" " "	" "	25 00
217	" "	"	" " "	Oct. 7, '85.	....
290	" "	Burlington	H. I. Budd, Mt. Holly	Nov. 19, '85.	22 00
268	" " White Dent	Sussex	W. S. Vanderhuff, Deckertown.	Nov. 14, '85.	28 00
269	" " 8-Rowed, Yellow	"	W. S. Vanderhuff, Deckertown.	" "	28 00
282	Corn Meal, Yellow Flint	Salem	Omar Borton, Woodstown.	Oct. 26, '85.	22 00
302	" " " "	Camden	Taylor Bros., Camden	Nov. 18, '85.	20 00
274	Corn, Yellow Flint	Sussex	W. S. Vanderhuff, Deckertown.	Nov. 14, '85.	....
273	Corn, White Flint	Sussex	W. S. Vanderhuff, Deckertown.	Nov. 14, '85.	....
308	Corn Meal, White Flint	Camden	Taylor Bros., Camden	Nov. 18, '85.	26 00
228	Corn Meal, Yellow Dent	Salem	Omar Borton, Woodstown.	Oct. 26, '85.	22 00
296	" " " "	Camden	Taylor Bros., Camden	Nov. 18, '85.	21 40
205	Coarse Corn Meal, Western	Middlesex	Director of Station	Oct. 7, '85.	....
256	" " " "	Morris	John J. Mitchell, Whippany.	Oct. 23, '85.	25 00
247	Corn Meal, Western	Middlesex	James Neilson, N. Brunswick.	Oct. 3, '85.	23 00
324	Corn Meal, Old and New Mixed	Burlington	H. I. Budd, Mt. Holly	Nov. 21, '85.	21 00
326	" " " " " "	"	" " " "	" "	21 00
285	Cracked Corn, New	Burlington	H. I. Budd, Mt. Holly	Nov. 19, '85.	22 00
284	New Feed, Indian	"	" " " "	" "	20 00
251	Corn and Cob Meal, White Flint	Morris	John J. Mitchell, Whippany.	Oct. 23, '85.	22 00
270	Corn Meal, White & Yellow with Cob	Sussex	W. S. Vanderhuff, Deckertown.	Nov. 14, '85.	22 00
325	New Corn Cob Meal	Burlington	H. I. Budd, Mt. Holly	Nov. 21, '85.	17 00
282	Cob Meal	"	" " " "	Nov. 19, '85.	16 00

WHEAT BRAN.

Station number.	Brand.	Pounds per hundred of: Water.	Crude Fat.	Crude Ash.	Crude Proteine.	Carbohydrates, including Fiber.	Percentage of: Nitrogen.	Phosphoric Acid.	Potash.
207	Wheat Bran, Western	11.23	5.04	7.70	12.81	63.72	1.97	2.65	1.52
208	Pure Wheat Bran, Western	12.22	4.07	6.36	14.31	63.04	2.29	3.23	1.74
210	Wheat Bran, Western	12.32	3.40	5.84	16.00	62.44	2.56	2.97	1.58
315	" " "	11.80	2.96	6.83	14.81	63.60	2.37	3.40	1.87
317	" " "	12.90	3.45	7.03	14.69	61.93	2.35	3.37	1.87
318	" " "	12.10	3.54	6.73	14.94	62.69	2.39	3.20	1.79
	Average	**12.09**	**3.77**	**6.79**	**14.51**	**62.90**	**2.32**	**3.13**	**1.73**
231	Wheat Bran, Old Process	11.20	4.25	5.99	14.81	63.75	2.37	2.93	1.65
249	" " " "	11.63	2.94	6.50	14.19	64.74	2.27	3.21	1.66
260	" " " "	13.10	2.84	4.01	17.31	62.74	2.77	1.70	1.03
	Average	**11.97**	**3.34**	**5.50**	**15.43**	**63.74**	**2.47**	**2.61**	**1.45**
235	Coarse Bran, New Process	11.42	2.92	5.98	16.06	63.62	2.57	2.87	1.58
236	Fine Bran, " "	12.39	4.45	4.77	17.94	60.45	2.87	2.38	1.32
294	Wheat " " "	12.05	3.73	6.36	15.50	62.36	2.48	3.18	1.60
	Average	**11.95**	**3.70**	**5.70**	**16.50**	**62.14**	**2.64**	**2.81**	**1.50**
209	Wheat Bran	13.72	3.52	6.13	15.56	61.07	2.49	2.99	1.62
262	" "	10.90	3.62	6.31	15.31	63.86	2.45	3.23	1.68
279	" "	12.20	1.85	7.78	14.00	64.17	2.24	4.19	2.09
312	" "	11.95	2.45	5.65	15.19	64.76	2.43	2.73	1.56
313	" "	12.05	2.44	5.79	13.44	66.28	2.15	2.82	1.62
300	Southern Wheat Bran, Old Process	12.59	2.98	5.66	14.94	63.83	2.39	2.87	1.49
	Average	**12.23**	**2.81**	**6.22**	**14.74**	**63.99**	**2.36**	**3.14**	**1.68**

MISCELLANEOUS SAMPLES.

Station number.	Brand.	Pounds per hundred of: Water.	Crude Fat.	Crude Ash.	Crude Proteine.	Carbohydrates, including Fiber.	Percentage of: Nitrogen.	Phosphoric Acid.	Potash.
239	Pea Feed	10.09	1.17	3.02	14.94	70.78	2.39	0.72	0.72
240	Pea Meal	11.35	1.97	2.50	26.56	57.62	4.25	0.91	0.99
267	Hominy Meal, Western	7.39	7.59	2.69	10.13	72.20	1.62	1.41	0.74
303	Corn Bran	7.66	3.97	1.42	6.94	80.01	1.11	0.49	0.47
305	Malt Sprouts	10.47	1.40	12.48	14.81	60.84	3.97	1.46	1.65
310	Broom Corn Seed	8.88	2.57	4.48	10.69	73.38	1.71	0.72	0.52

WHEAT BRAN.

Station number.	BRAND.	COUNTY.	SAMPLED BY	Date of Sampling.	Cost per Ton.
207	Wheat Bran, Western	Middlesex	Director of Station	Oct. 12, '85.	$20 00
208	Pure Wheat Bran, Western	"	" " "	" "	18 00
210	Wheat Bran, "	"	" " "	" "	20 00
315	" " "	Burlington	H. I. Budd, Mt Holly	Nov. 19, '85.	18 00
317	" " "	"	" " " "	Nov. 21, '85.	18 00
318	" " "	"	" " " "	Nov. 23, '85.	19 00
231	Wheat Bran, Old Process	Salem	Omar Borton, Woodstown.	Oct. 26, '85.	18 00
249	" " " "	Morris	John J. Mitchell, Whippany.	Oct. 28, '85.	20 00
260	" " " "	"	John J. Mitchell, Whippany.	Oct. 29, '85.	25 00
285	Coarse Bran, New Process	Salem	Omar Borton, Woodstown.	Oct. 26, '85.	18 00
286	Fine Bran, " "	"	Omar Borton, Woodstown.	" "	18 00
294	Wheat Bran	Camden	Taylor Bros., Camden	Nov. 18, '85.	16 00
209	Wheat Bran	Middlesex	Director of Station	Oct. 7, '85.	....
262	" "	Sussex	W. S. Vanderhuff, Deckertown.	Nov. 14, '85.	19 00
279	" "	Burlington	H. I. Budd, Mt. Holly	Nov. 19, '85.	18 00
312	" "	"	" " " "	Nov. 23, '85.	20 00
318	" "	"	" " " "	Nov. 21, '85.	18 00
300	Southern Wheat Bran, Old Process	Camden	Taylor Bros., Camden	Nov. 18, '85.	17 00

MISCELLANEOUS SAMPLES.

Station number.	BRAND.	COUNTY.	SAMPLED BY	Date of Sampling.	Price per Ton.
239	Pea Feed	....	R. K. Buckman, N.Y.	Nov. —, '85.	$20 00
240	Pea Meal	....	" " "	" "	40 00
267	Hominy Meal, Western	Sussex	W. S. Vanderhuff, Deckertown.	Nov. 14, '85.	22 00
303	Corn Bran	Camden	Taylor Bros., Camden	Nov. 18, '85.	17 00
305	Malt Sprouts	"	Louis T. Derousse, Camden.	" "	12 75
310	Broom Corn seed	"	Taylor Bros., Camden	" "	....

WHEAT MIDDLINGS.

Station number.	Brand.	POUNDS PER HUNDRED OF					PERCENTAGE OF		
		Water.	Crude Fat.	Crude Ash.	Crude Proteine.	Carbohydrates, including Fiber.	Nitrogen.	Phosphoric Acid.	Potash.
219	Middlings	12.51	2.91	1.94	14.88	67.76	2.38	0.69	0.50
229	Wheat Middlings	13.04	3.00	2.02	14.75	67.19	2.36	0.98	0.58
292	" "	10.80	2.52	2.10	13.62	70.96	2.18	1.04	0.54
227	" " New Process	12.03	3.91	2.23	14.75	67.05	2.36	1.04	0.58
237	" " Old Process	13.66	3.25	2.08	13.25	67.81	2.12	1.01	0.53
	Average	**12.41**	**3.12**	**2.06**	**14.25**	**68.15**	**2.28**	**0.95**	**0.55**
259	Western Wheat Middlings	12.33	3.92	3.32	16.00	61.43	2.56	1.79	0.94
265	" " "	9.82	3.28	2.81	16.69	67.40	2.67	1.42	0.74
264	" " "	12.06	3.73	4.52	16.81	62.88	2.69	2.39	1.25
319	" " "	12.75	2.72	1.61	12.94	69.98	2.07	0.85	0.42
320	" " "	12.96	3.63	3.29	16.88	63.24	2.70	1.64	0.84
	Average	**11.98**	**3.45**	**3.11**	**15.86**	**65.59**	**2.54**	**1.62**	**0.84**
218	Fine Wheat Shorts	12.06	3.40	1.99	13.44	69.11	2.15	1.10	0.53
280	White Middlings	12.37	2.77	1.68	14.00	69.18	2.24	0.87	0.45
289	Brown "	12.89	3.69	2.67	14.69	66.56	2.35	1.30	0.76
307	Flour "	11.43	3.43	2.24	16.18	66.77	2.58	1.08	0.56
	Average	**12.06**	**3.32**	**2.14**	**14.56**	**67.91**	**2.33**	**1.06**	**0.57**
283	Round Stuff or Middlings	11.93	3.34	2.11	14.50	68.12	2.32	0.95	0.52
245	Wheat Feed	10.66	4.27	5.28	16.00	63.79	2.56	2.77	1.34
278	" Ship	11.83	2.45	6.12	15.00	64.60	2.40	2.69	0.43

BUCKWHEAT FLOUR, BRAN AND GRAIN.

Station number.	Brand.	POUNDS PER HUNDRED OF					PERCENTAGE OF		
		Water.	Crude Fat.	Crude Ash.	Crude Proteine.	Carbohydrates, including Fiber.	Nitrogen.	Phosphoric Acid.	Potash.
248	Buckwheat Bran, Jersey	13.22	5.53	4.48	20.06	56.71	3.21	1.59	1.11
254	" " "	13.01	6.08	3.75	23.56	53.27	3.77	1.78	1.03
263	" " Middling	13.06	4.90	3.59	18.87	59.58	3.02	1.63	0.98
322	" " "	14.55	4.58	3.50	17.38	59.99	2.78	1.52	0.98
	Average	**13.55**	**5.27**	**3.83**	**19.99**	**57.39**	**3.19**	**1.62**	**1.02**
271	Buckwheat Flour	16.19	0.64	0.52	4.19	78.42	0.67	0.57	0.16
275	" "	15.82	0.63	0.51	3.88	79.16	0.62	0.41	0.15
	Average	**16.00**	**0.64**	**0.52**	**4.03**	**78.79**	**0.64**	**0.52**	**0.16**
291	Buckwheat Bran, Old Process	16.04	2.19	2.42	10.00	69.35	1.60	0.68	0.75
311	Buckwheat, Unground	10.77	2.45	2.28	10.18	74.87	1.62	0.78	0.59

WHEAT MIDDLINGS.

Station number.	BRAND.	COUNTY.	SAMPLED BY	Date of Sampling.	Cost per Ton.
219	Wheat Middlings........................	Middlesex.	Director of Station.................	Oct. 7, '85.	....
229	" "	Salem.........	Omar Borton, Woodstown.....	Oct. 26, '85.	$23 00
292	" "	Camden	Taylor Bros., Camden...........	Nov. 18, '85.	20 00
227	" " New Process..	Salem.........	Omar Borton, Woodstown.....	Oct. 26, '85.	23 00
257	" " Old Process...	Morris........	John J. Mitchell, Whippany..	Oct. 28, '85.	....
259	Western Wheat Middlings.......	Morris........	John J. Mitchell, Whippany..	Oct. 28, '85.	20 00
265	" " "	Sussex	William S. Vanderhuff, Deckertown.	Nov. 14, '85.	25 00
264	" " "	"	William S. Vanderhuff, Deckertown.	" "	20 00
319	" " "	Burlington	H. I. Budd, Mt. Holly...........	Nov. 23, '85.	29 00
320	" " "	"	" " "	Nov. 21, '85.	23 00
218	Fine Wheat Shorts..................	Middlesex.	Director of Station.................	Oct. 12, '85.	26 00
280	White Middlings......................	Burlington	H. I. Budd, Mt. Holly...........	Nov. 19, '85.	25 00
289	Brown "	"	" " "	" "	20 00
307	Flour "	Camden.....	Louis T. Derousse, Camden...	Nov. 18, '85.	21 50
238	Round Stuff or Middlings........	Salem.........	Omar Borton, Woodstown.....	Oct. 26, '85.	23 00
245	Wheat Feed, Western................	Middlesex.	Jas. Neilson, New Brunswick.	Oct. 3, '85.	16 50
278	Wheat Ship..............................	Burlington	H. I. Budd, Mt. Holly...........	Nov. 19, '85.	18 00

BUCKWHEAT FLOUR, BRAN AND GRAIN.

Station number.	BRAND.	COUNTY.	SAMPLED BY	Date of Sampling.	Cost per Ton.
218	Buckwheat Bran, Jersey..........	Morris	John J. Mitchell, Whippany.	Oct. 29, '85.	$20 00
254	" "	"	" " "	Oct. 28, '85.	25 00
263	" " and Middlings.	Sussex	William S. Vanderhuff, Deckertown.	Nov. 14, '85.	20 00
322	" "	Burlington	H. I. Budd, Mt. Holly...........	Nov. 21, '85.	17 00
271	Buckwheat Flour.....................	Sussex	William S. Vanderhuff, Deckertown.	Nov. 14, '85.	50 00
275	" "	Burlington	H. I. Budd, Mt. Holly...........	Nov. 19, '85.	55 00
291	Buckwheat Bran, Old Process..	Burlington.	H. I. Budd, Mt. Holly...........	Nov. 19, '85.	16 00
311	" Unground...............	Camden.....	Taylor Bros., Camden...........	Nov. 18, '85.	27 00

GROUND RYE AND RYE BRAN.

Station number.	BRAND.	POUNDS PER HUNDRED OF Water.	Crude Fat.	Crude Ash.	Crude Proteine.	Carbohydrates, including Fiber.	PERCENTAGE OF Nitrogen.	Phosphoric Acid.	Potash.
230	Ground Rye	13.22	1.80	1.66	9.50	73.82	1.52	0.77	0.58
284	" "	12.77	2.00	1.84	10.50	72.89	1.68	0.75	0.34
266	Clear Rye Feed	11.35	1.59	1.85	10.25	74.96	1.62	0.82	0.51
288	Ground Rye	12.61	1.63	1.99	11.69	72.08	1.87	0.92	0.61
321	" "	13.10	1.55	1.98	10.00	73.37	1.60	0.85	0.58
301	Rye, Unground	9.15	1.66	1.77	9.06	78.36	1.45	0.73	0.57
	Average	**12.03**	**1.71**	**1.84**	**10.16**	**74.24**	**1.62**	**0.81**	**0.52**
250	Rye Bran	13.26	2.02	2.34	12.81	69.54	2.05	0.95	0.66
258	" " Old Process	10.62	1.70	2.61	12.94	72.13	2.07	1.19	0.81
287	" "	13.74	3.85	3.66	13.63	65.09	2.18	1.83	1.13
314	" "	12.39	2.96	3.11	13.31	68.23	2.13	1.50	0.97
316	" "	11.68	2.60	3.06	14.38	68.28	2.30	1.47	0.93
	Average	**12.34**	**2.63**	**2.96**	**13.41**	**68.65**	**2.14**	**1.39**	**0.90**
283	Rye Middlings	....	......	1.87	10.56	....	1.69	0.66	0.46

MIXED FEED.

Station number.	BRAND.	POUNDS PER HUNDRED OF Water.	Crude Fat.	Crude Ash.	Crude Proteine.	Carbohydrates, including Fiber.	PERCENTAGE OF Nitrogen.	Phosphoric Acid.	Potash.
206	Corn and Oats	13.65	3.53	2.12	9.13	71.57	1.46	0.76	0.41
211	" " " Equal Parts	11.25	4.33	1.88	10.38	72.16	1.66	0.65	0.46
218	" " " " "	12.34	3.98	2.73	9.44	71.51	1.51	0.90	0.46
226	" " " " "	11.35	5.00	2.23	9.94	71.48	1.59	0.65	0.45
246	" " " Unequal Parts	11.11	4.45	3.61	10.44	70.39	1.67	0.78	0.51
277	" " " Equal Parts	12.41	4.14	2.02	8.38	73.05	1.34	0.50	0.49
298	" " " " "	10.72	4.35	1.90	9.38	73.65	1.50	0.79	0.42
323	" " " " "	13.07	4.31	2.31	9.94	70.37	1.59	0.74	0.38
	Average	**11.99**	**4.26**	**2.35**	**9.63**	**71.77**	**1.54**	**0.65**	**0.45**
252	Corn, Rye and Oats	10.41	3.35	1.95	10.56	73.73	1.69	0.72	0.78
272	" " " "	11.78	3.05	2.01	8.82	74.34	1.41	0.75	0.52
	Average	**11.09**	**3.20**	**1.98**	**9.69**	**74.03**	**1.55**	**0.73**	**0.65**
255	Corn Cob and Oats	14.04	3.69	1.53	7.94	72.80	1.27	0.47	0.44
215	Corn and Oats, ⅔ and ⅓, Jersey	13.42	3.47	1.67	8.75	72.69	1.40	0.65	0.42
261	Corn and Bran Feed, 8-5	11.48	4.03	2.71	10.56	71.22	1.69	1.30	0.83

GROUND RYE AND RYE BRAN.

Station number.	BRAND.	COUNTY.	SAMPLED BY	Date of Sampling.	Cost per Ton.
230	Ground Rye	Salem	Omar Borton, Woodstown.	Oct. 26, '85.	$27 00
284	“ “	“	Omar Borton, Woodstown.	“ “	26 00
266	Clear Rye Feed	Sussex	W. S. Vanderhuff, Deckertown.	Nov. 14, '85.	28 00
288	Ground Rye	Burlington	H. I. Budd, Mt. Holly	Nov. 19, '85.	24 00
321	“ “	“	“ “ “	Nov. 21, '85.	23 00
301	Rye, Unground	Camden	Taylor Bros., Camden	Nov. 18, '85.	24 80
250	Rye Bran	Morris	John J. Mitchell, Whippany.	Oct. 29, '85.	25 00
258	“ “ Old Process	“	John J. Mitchell, Whippany.	Oct. 23, '85.	25 00
297	“ “	Burlington	H. I. Budd, Mt. Holly	Nov. 19, '85.	18 00
314	“ “	“	“ “ “	Nov. 21, '85.	20 00
316	“ “	“	“ “ “	Nov. 23, '85.	21 00
288	Rye Middlings	Burlington	H. I. Budd, Mt. Holly	Nov. 19, '85.	22 00

MIXED FEED.

Station number.	BRAND.	COUNTY.	SAMPLED BY	Date of Sampling.	Price per Ton.
206	Corn and Oats	Middlesex	Director of Station	Oct. 12, '85.	....
211	“ “ “ Equal Parts	“	“ “ “	“ “	$24 00
218	“ “ “ “ “	“	“ “ “	Oct. 7, '85.	....
226	“ “ “ “ “	Salem	Omar Borton, Woodstown.	Oct. 26, '85.	....
246	“ “ “ *	Middlesex	James Neilson, N. Brunswick.	Oct. 3, '85.	24 00
277	“ “ “ Equal Parts	Burlington	H. I. Budd, Mt. Holly	Nov. 19, '85.	24 50
298	“ “ “ “ “	Camden	Taylor Bros., Camden	Nov. 18, '85.	22 00
323	“ “ “ “ “	Burlington	H. I. Budd, Mt. Holly	Nov. 21, '85.	23 00
252	Corn, Rye and Oats	Morris	J. J. Mitchell, Whippany.	Oct. 23, '85.	25 00
272	“ “ “ “	Sussex	W. S. Vanderhuff, Deckertown.	Nov. 4, '85.	28 00
255	Corn Cob and Oats	Morris	John J. Mitchell, Whippany.	Oct. 23, '85.	25 00
215	Corn and Oats	Middlesex	Director of Station	Oct. 12, '85.	25 00
261	Corn and Bran Feed †	“	L. H. Roe	Oct. 7, '85.	23 00

* With only enough corn to cause it to grind. † 800 lbs. corn; 500 lbs. bran, mixed.

OIL MEAL, FLAX SEED MEAL AND COTTON SEED MEAL.

Station number.	BRAND.	POUNDS PER HUNDRED OF					PERCENTAGE OF		
		Water.	Crude Fat.	Crude Ash.	Crude Proteine.	Carbohydrates, includ'g Fiber.	Nitrogen.	Phosphoric Acid.	Potash.
220	Oil Meal	9.75	6.69	6.61	32.00	44.95	5.12	1.61	1.16
221	" "	9.32	7.13	5.70	34.25	43.60	5.48	2.05	1.48
222	" "	10.30	7.80	5.36	32.19	44.85	5.15	1.90	1.41
223	" "	10.19	7.73	5.54	33.68	42.91	5.38	1.96	1.48
241	" "	10.52	7.22	5.50	32.94	43.82	5.27	1.82	1.37
293	" "	6.69	7.58	6.31	31.81	47.61	5.09	1.99	1.44
	Average	**9.46**	**7.41**	**5.84**	**32.80**	**44.54**	**5.25**	**1.89**	**1.39**
242	Flax Seed Meal	8.82	33.57	3.62	25.75	28.24	4.12	1.21	0.93
306	" " "	7.77	31.69	4.44	22.31	33.79	3.57	1.39	0.93
	Average	**8.29**	**32.63**	**4.03**	**24.03**	**31.01**	**3.84**	**1.30**	**0.93**
258	Cotton Seed Meal	10.67	10.38	6.58	43.25	29.06	6.92	2.94	1.82
299	" " "	7.99	12.88	6.48	44.31	28.39	7.09	2.69	1.77
	Average	**9.33**	**11.63**	**6.53**	**43.79**	**28.72**	**7.00**	**2.81**	**1.80**
296	Oil Meal, New Process	8.61	2.35	6.04	35.69	47.31	5.71	2.22	1.59

OATS.

Station number.	BRAND.	POUNDS PER HUNDRED OF					PERCENTAGE OF		
		Water.	Crude Fat.	Crude Ash.	Crude Proteine.	Carbohydrates, includ'g Fiber.	Nitrogen.	Phosphoric Acid.	Potash.
225	Oats, Heavy	11.47	5.60	3.97	10.88	68.08	1.74	0.79	0.55
238	" "	10.68	5.61	2.69	12.56	68.46	2.01	0.73	0.52
309	" "	10.72	4.90	3.56	11.19	69.63	1.79	0.79	0.50
	Average	**10.95**	**5.37**	**3.41**	**11.54**	**68.72**	**1.84**	**0.77**	**0.52**
224	Oats, Light	11.17	5.97	3.81	10.69	68.36	1.70	0.68	0.56
237	" "	11.48	4.83	2.80	12.06	68.78	1.93	0.83	0.61
297	" "	11.06	4.97	3.25	9.00	71.72	1.44	0.82	0.54
	Average	**11.23**	**5.27**	**3.28**	**10.58**	**69.62**	**1.69**	**0.77**	**0.57**
243	White Oats	11.52	4.57	3.54	12.88	67.48	2.06	0.79	0.61
244	Yellow Oats	11.27	4.85	3.26	11.63	68.99	1.86	0.74	0.65

OIL MEAL, FLAX SEED MEAL AND COTTON SEED MEAL.

Station number.	BRAND.	COUNTY WHERE SAMPLED.	SAMPLED BY	Date of Sampling.	Cost per ton.
220	Linseed, or Oil Meal...........................	Middlesex.....	Director of Station....	Oct. 7, '85.	....
221	" " "	"	" " " ...	Oct. 12, '85.	$40 00
222	" " "	"	" " " ...	Oct. 12, '85.	40 00
223	" " "	"	" " " ...	Oct. 12, '85.	40 00
241	" " "	"	James Neilson, New Brunswick	Oct. 8, '85.	†38 00
298	" " "	Camden........	Taylor Bros.,Camden	Nov. 18, '85.	30 00
242	*Ground Flax Seed............................	Middlesex.....	James Neilson, New Brunswick	Oct. 8, '85.	70 00
306	*Ground Flax Seed............................	Camden........	Louis T. Derousse, Camden.	Nov. 18, '85.	80 00
253	Cotton Seed Meal................................	Essex..............	John J. Mitchell, Whippany.	Oct. 23, '85.	23 00
299	" " "	Camden........	Taylor Bros.,Camden	Nov. 18, '85.	26 00
295	Linseed, or Oil Meal, New Process....	Camden.........	Taylor Bros.,Camden	Nov. 18, '85	30 00

OATS.

Station number.	BRAND.	COUNTY.	SAMPLED BY	Date of Sampling.	Cost per ton.
225	Oats, Heavy...	Middlesex.....	Director of Station....	Oct. 7, '85.	....
233	" "	Salem............	Omar Borton, Woodstown.	Oct. 26, '85.	$23 32
309	" "	Camden........	Taylor Bros.,Camden	Nov. 18, '85.	25 00
224	Oats, Light	Middlesex.....	Director of Station....	Oct. 7, '85.	....
237	" "	Salem............	Omar Borton, Woodstown.	Oct. 26, '85.	23 32
297	" "	Camden........	Taylor Bros.,Camden	Nov. 18, '85.	23 80
243	White Oats...	Middlesex.....	James Neilson, New Brunswick	Oct. 8, '85.	....
244	Yellow Oats...	"	James Neilson, New Brunswick	Oct. 8, '85.	....

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* Ground Flax Seed differs from Linseed Meal in not having had its oil extracted.

† $38 per ton in New York, f.o.b., in five-ton lots.

THE MAXIMUM, MINIMUM AND AVERAGE COMPOSITION OF FEEDS.

BRAND.	FROM THE REPORT OF	Number of Analyses.	DRY MATTER.			PROTEINE.			FAT.			NITROGEN, FREE EXTRACT.			CRUDE FIBER.			ASH.
			Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	
Corn Meal, all Varieties......	Professor Julius Kuhn...............	......	77.60	91.80	87.30	5.80	15.10	10.60	1.50	9.20	6.50	52.40	72.70	65.70	1.80	8.50	2.80	1.70
	Dr. E. H. Jenkins, Conn. Station.	176	79.30	94.02	89.51	7.00	15.31	10.62	3.40	7.13	5.49	61.78	75.73	69.72	0.78	5.24	2.18	1.55
	New Jersey Station....................	7	86.43	88.25	87.21	8.63	9.44	9.09	8.62	4.55	4.08	....	....	....	....	....	....	1.37
Western Corn...	Professor Julius Kuhn...............	......	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Dr. E. H. Jenkins, Conn. Station.	3	79.30	83.60	80.90	7.80	8.60	8.30	3.60	3.90	3.70	64.90	68.20	66.00	1.70	1.80	1.75	1.20
	New Jersey Station....................	8	87.21	88.21	87.80	8.31	9.56	8.97	3.95	4.11	4.02	....	....	....	....	....	....	1.53
Flint Corn.......	Professor Julius Kuhn...............	......	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Dr. E. H. Jenkins, Conn. Station.	63	81.84	93.41	88.93	7.00	13.65	10.67	3.40	7.13	5.00	67.95	74.62	70.08	0.78	2.88	1.71	1.47
	New Jersey Station....................	5	86.95	90.42	88.69	8.88	10.44	9.62	3.09	4.82	4.18	....	....	....	....	....	....	1.44
Dent Corn.......	....	......	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Dr. E. H. Jenkins, Conn. Station.	77	85.95	93.78	89.93	7.53	12.07	10.36	3.80	6.98	5.15	66.26	75.73	70.60	1.25	4.81	2.29	1.53
	New Jersey Station....................	2	86.07	86.89	86.48	8.56	8.75	8.65	3.18	4.65	3.92	....	....	....	....	....	....	1.24
Oats.................	Professor Julius Kuhn...............	......	83.60	92.40	86.80	6.30	18.50	12.00	4.40	7.30	6.00	48.00	71.80	56.60	4.10	16.10	9.00	2.70
	Dr. E. H. Jenkins, Conn. Station.	21	86.50	91.10	89.30	8.00	14.40	11.30	4.10	5.80	5.00	57.10	66.90	61.00	1.50	12.90	9.00	3.00
	New Jersey Station....................	8	88.48	89.32	88.83	9.00	12.88	11.36	4.57	5.97	5.17	....	....	....	....	....	....	3.36

THE MAXIMUM, MINIMUM AND AVERAGE COMPOSITION OF FEEDS.

BRAND.	FROM THE REPORT OF	Analyses.	DRY MATTER.			PROTEINE.			FAT.			NITROGEN, FREE EXTRACT.			CRUDE FIBER.			ASH.
			Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	
Wheat Bran........	Professor Julius Kuhn.............	...	83.50	92.40	87.00	10.10	17.00	14.50	1.70	6.60	3.50	28.50	61.50	58.60	4.10	34.60	9.40	6.00
	Dr. E. H. Jenkins, Conn. Station.	2	85.82	91.85	87.98	7.81	16.89	14.54	2.39	5.84	3.66	50.41	58.93	55.16	7.24	16.64	8.79	5.83
	New Jersey Station.....................	18	86.28	89.10	87.91	12.31	17.94	15.01	1.85	5.04	3.30	....	....	....	....	....	....	6.21
Wheat Middlings	Professor Julius Kuhn.............	...	86.00	88.50	87.10	12.60	15.20	14.60	2.60	3.30	3.00	61.60	64.90	63.80	1.40	4.80	3.10	2.60
	Dr. E. H. Jenkins, Conn. Station.	9	86.15	89.44	88.03	10.13	15.00	12.27	2.07	4.35	3.23	60.21	70.86	65.48	3.47	7.45	4.58	2.47
	New Jersey Station	11	86.34	90.18	87.83	12.94	16.88	14.92	2.52	3.92	3.29	....	....	....	....	....	....	2.54
Wheat Shorts......	Professor Julius Kuhn..............	...	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Dr. E. H. Jenkins, Conn. Station.	6	86.41	89.04	88.15	11.13	15.13	13.14	2.50	4.85	3.79	55.62	62.32	58.96	6.34	10.47	7.94	4.32
	New Jersey Station.....................	4	87.61	88.57	87.94	13.44	16.13	14.56	2.77	3.69	3.32	....	....	....	....	....	....	2.14
Rye.....................	Professor Julius Kuhn.................	...	81.70	91.40	85.70	7.90	17.40	11.40	0.90	2.80	1.70	62.50	72.40	67.80	1.10	6.70	3.00	1.80
	Dr. E. H. Jenkins, Conn. Station.	6	86.30	91.30	88.40	9.50	12.10	10.60	1.40	2.10	1.70	70.70	73.90	72.60	1.40	2.10	1.60	1.90
	New Jersey Station.....................	6	86.78	90.85	87.97	9.06	11.69	10.16	1.55	2.00	1.71	....	....	....	....	....	....	1.84
Rye Bran............	....	...	81.60	93.50	87.50	10.10	18.10	14.50	1.90	5.00	3.50	32.90	64.60	57.10	4.20	28.50	7.20	5.20
	Dr. E. H. Jenkins, Conn. Station.	3	86.30	89.70	87.70	12.60	16.50	15.26	1.79	2.60	2.19	59.75	67.00	63.12	2.50	4.00	3.51	3.62
	New Jersey Station	5	86.26	89.88	87.66	12.81	14.38	13.41	1.70	3.85	2.63	....	....	....	....	....	....	2.96

THE MAXIMUM, MINIMUM AND AVERAGE COMPOSITION OF FEEDS.

BRAND.	FROM THE REPORT OF	Analyses.	DRY MATTER.			PROTEINE.			FAT.			NITROGEN, FREE EXTRACT.			CRUDE FIBER.			ASH.
			Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	
Buckwheat Flour	Professor Julius Kuhn	...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	Dr. E. H. Jenkins, Conn. Station.	8	85.06	87.22	86.48	4.18	8.00	6.48	0.65	1.74	1.83	75.81	79.83	77.84	0.21	0.85	0.28	1.05
	New Jersey Station	2	83.81	84.18	84.00	3.88	4.19	4.03	0.63	0.64	0.64	......	......	......	......	......	......	0.52
Linseed Meal	Professor Julius Kuhn	...	81.10	92.90	87.80	20.60	37.80	29.50	6.00	18.20	10.00	19.70	41.30	29.80	5.10	16.80	9.70	8.80
	Dr. E. H. Jenkins, Conn. Station.	4	87.53	93.83	91.28	27.68	33.95	31.28	5.16	11.57	8.72	31.45	41.89	37.75	7.12	7.57	7.34	6.24
	New Jersey Station	6	89.48	93.31	90.51	31.81	34.25	32.80	6.69	7.80	7.41	......	......	......	......	......	......	5.84
Linseed Meal, New Process.	Professor Julius Kuhn	...	85.40	90.80	88.00	24.90	35.10	32.70	0.70	3.80	2.30	24.50	39.90	36.40	6.70	10.80	8.80	7.80
	Dr. E. H. Jenkins, Conn. Station.	6	86.65	93.21	89.49	27 10	37.10	33.45	1.80	4.01	2.83	35.22	48.08	38.78	7.58	9.00	8.37	6.06
	New Jersey Station	1	......	......	91.89	......	......	35.69	......	......	2.35	......	......	......	......	......	......	6.04
Cotton Seed Meal	Professor Julius Kuhn	...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	Dr. E. H. Jenkins, Conn. Station	22	90.87	94.82	92.17	22.27	50.81	42.45	10.24	18.01	13.36	12.74	38.63	23.49	2.77	11.76	5.67	7.20
	New Jersey Station	2	89.33	92.01	90.67	43.25	44.31	43.79	10.39	12.88	11.63	......	......	......	......	......	......	6.53
Flax Seed Meal	Professor Julius Kuhn	...	87.70	93.20	88.20	20.00	23.50	21.70	21.70	39.00	35.60	9.00	35.70	19.60	3.20	18.00	7.90	3.40
	Dr. E. H. Jenkins, Conn. Station.	...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	New Jersey Station	2	91.28	92.28	91.71	22.31	25.75	24.08	31.69	33.57	32.63	......	......	......	......	......	......	4.08

THE DAIRY BUSINESS.

FINANCIALLY CONSIDERED.

On the 17th of January, 1884, an experienced man was engaged by the Station to weigh daily, all of the feed and fodder consumed by the milch cows in the College Farm barn. It was also this man's duty to weigh the milk from each cow separately, and to place each record on file in the Station's Laboratory. This work was ended upon the third of June; the period, therefore, included *one hundred and thirty-nine days.* Taken in connection with the farm books, this record furnishes reliable data for showing—

I. *The kind, quantity and value of the feeds and fodders eaten.*
II. *The quantity and value of the milk produced.*
III. *The expenses of production.*
IV. *The expenses of wholesaling and retailing milk.*
V. *The profits.*

This herd averaged, approximately, thirty-five cows; it was in charge of an experienced farmer, and was managed in accordance with opinions generally entertained by dairymen in the northern and central counties of this State. Its record, therefore, may be regarded as typical of a large number of similar herds in various sections of New Jersey.

I.

THE KIND, QUANTITY AND VALUE OF THE FOOD CONSUMED BY A HERD OF THIRTY-FIVE COWS IN ONE HUNDRED AND THIRTY-NINE-DAYS.

	Total Amount, in Pounds, of each Article of Food Consumed from January 17th through June 3d.	Cost per Ton of each Article of Food.	Total Cost of each Article of Food Consumed from January 17th through June 3d.	COST OF EACH ARTICLE OF FOOD FOR PERIODS.		
				I.	II.	III.
				January 17th through March 3d.	March 4th through April 6th.	April 7th through June 3d.
Brewers' Grains	137,385	$5 20	$357 20	$121 00	$79 77	$156 43
Corn Meal	20,320	24 00	243 84	88 09	60 63	95 11
Cotton Seed Meal	10,528	27 00	142 14	56 03	33 70	52 41
Linseed Meal	6,784	32 00	108 04	38 70	24 14	45 70
Wheat Chaff	7,473	5 00	18 69	6 06	5 44	7 19
Timothy Hay	9,587	14 00	66 76	18 48	18 59	29 69
Corn Ensilage	73,133	3 00	109 70	29 87	24 85	55 98
Clover Ensilage	3,360	2 00	3 36	1 02	2 34	....
Sorghum Ensilage	4,800	3 00	7 20	....	....	7 20
Dried Brewers' Grains	2,684	20 00	26 84	4 26	8 16	13 92
Dried Corn Stalks	1,426	7 00	4 99	2 36	1 69	95
Clover Hay	3,456	8 00	13 82	....	2 69	11 13
Total	....	....	$1,102 58	$365 87	$261 60	$475 71

II.

THE QUANTITY AND VALUE OF THE MILK PRODUCED BY THIRTY-FIVE COWS IN ONE HUNDRED AND THIRTY-NINE DAYS.

15,236	quarts of milk sold in New Brunswick (retail)	$1,093 42
30,900	" " " " " Jersey City (wholesale)	1,342 20
695	" " " used upon the farm, at 3.397 cents	23 61
2.135	" " " lost as dippage, &c., at 3.397 cents	72 53
48,966	quarts of milk, worth	$2,531 76

III.

THE EXPENSE OF PRODUCING 48,966 QUARTS OF MILK.

Feeds and fodders			$1,102 58
Labor, losses, &c., viz :			
Decrease in value of cows—			
16 cows and 14 calves bought	$806 00		
16 " " 14 " sold	707 16		
		$98 84	
Wages paid William or substitute, 139 days		157 53	
" " Frank, 139 days		139 00	
Interest, 139 days, at 5 per cent. upon value of herd		34 75	
Loss by death		40 44	
Fodder for 6 dry cows, 139 days, at 8 cents		66 72	
695 quarts of milk used on farm, salary account		23 61	
			560 89
Total expenses of production			$1,663 47

IV.

WHOLESALING AND RETAILING EXPENSES.

WHOLESALE.

Freight to Jersey City, upon 30,900 quarts of milk, at 0.5 cents	$154 50	
Cartage expenses from farm to depot	23 21	
		$177 71

RETAIL.

Drivers' wages, $166.80, less 10 per cent. charged cartage on wholesale account	$150 12	
Food for horse, $55 60, less 10 per cent. charged cartage on wholesale account	50 04	
Interest, wear and tear, &c., upon wagon, $9.73, less 10 per cent. above account	8 76	
2,135 quarts of milk lost as dippage and waste	72 53	
		$281 45

V.

PROFITS.

48,966 quarts of milk, produced in 139 days		$2,531 76
Production expenses	$1,663 47	
Wholesaling "	177 71	
Retailing "	281 45	
		2,122 63
139 days' profit on milk from thirty-five cows		$409 13

The points to be decided are—

I. The relative profits from wholesaling and retailing milk.
II. The study of methods by which profits may be increased.

I.

THE RELATIVE PROFITS FROM WHOLESALING AND RETAILING MILK.

COST PER QUART OF PRODUCING MILK.

Periods.	Number of Days in each Period.	Number of Cows Milked During each Period.	Number of Quarts of Milk Produced.	Cost of Food Eaten During each Period.	Cost of Production other than Food.	Total Cost of Producing Milk.	Cost per Quart of Producing Milk.
							cts.
January 17th to March 3d	47	33	14,292	$365 37	$189 65	$555 02	3.90
March 4th to April 6th	34	33	11,881	261 50	137 19	398 69	3.50
April 7th to June 3d	58	35	23,368	475 71	234 05	709 76	3.038
	139	....	48,966	$1,102 58	$560 89	$1,663 47	....

Average Cost of Producing Milk, per Quart, 3.397 Cents.

COST PER QUART OF WHOLESALING AND RETAILING MILK.

	WHOLESALE.					RETAIL.			
	Quarts of Milk Sold at Wholesale, per Period.	Freight upon Milk to Jersey City, One-half Cent per Quart.	Cartage upon Milk at New Brunswick.	Total Cost of Wholesaling Milk.	Cost per Quart of Wholesaling Milk.	Quarts of Milk Sold at Retail, per Period.	Number of Days in each Period.	Retailing Expenses, per Period.	Retailing Expenses, per Quart.
					cts.				cts.
January 17th to March 3d.	8,220	$41 10	$7 85	$48 95	0.595	5,383	47	$95 17	1.768
March 4th to April 6th......	6,500	32 50	5 68	38 18	0.587	4,339	34	68 84	1.586
April 7th to June 3d.........	16,180	80 90	9 68	90 58	0.559	5,514	58	117 44	2.130
	30,900	$154 50	$23 21	$177 71	....	15,236	139	$281 45	....

Average Quantity of Milk, Wholesale, Daily, 222 Quarts.

Average Wholesaling Expenses, 0.575 *Cents per Quart.*

Average Quantity of Milk Retailed Daily, 110 Quarts.

Average Retailing Expenses, 1.85 *Cents per Quart.*

PROFITS AND LOSSES FROM WHOLESALING MILK.

	Cost of Producing Milk per Quart.	Cost of Delivering Milk at the Jersey City Depot per Quart.	Total Expense to the Farm per Quart of Milk.	Price Received per Quart at Jersey City.	Profits to the Farm per Quart.	Loss to the Farm per Quart.	Total Number of Quarts of Milk Sold per Period.	Profits per Period.	Losses per Period.
	cts.	cts.	cts.	cts.	cts.	cts.			cts.
January 17th to March 1st	3.900	0.595	4.495	5.0	0.505	....	7,680	$38 78	....
March 1st to March 3d	3.900	0.595	4.495	4.5	0.005	....	540	03	....
March 4th to April 1st	3.500	0.580	4.080	4.5	0.415	....	5,340	22 16	....
April 1st to April 6th	3.500	0.580	4.080	4.0	....	0.080	1,160	....	0.10
April 7th to June 3d	3.038	0.559	3.597	4.0	0.403	....	16,180	65 21	....
							30,900	$126 18	....

Total Profits from Wholesaling 30,900 Quarts of Milk, $126.08.

PROFITS AND LOSSES FROM RETAILING MILK.

	Cost of Producing Milk per Quart.	Cost of Retailing Milk in New Brunswick per Quart.	Total Expense to the Farm per Quart of Milk.	Price Received per Quart in New Brunswick.	Profits to the Farm per Quart.	Total Number of Quarts Sold in New Brunswick per period.	Profits per Period.	Total Receipts for Milk per Period.
	cts.	cts.	cts.	cts.	cts.			
January 17th to March 3d	3.900	1.768	5.668	8	2.332	5,383	$125 53	$430 64
March 4th to April 1st	3.500	1.586	5.086	8	2.914	3,580	104 32	286 40
April 1st to April 6th	3.500	1.586	5.086	6	.914	759	6 94	45 54
April 7th to June 3d	3.038	2.130	5.168	6	.832	5,511	45 88	330 84
						15,236	$282 67	$1,093 42

Total Profits from Retailing 15,236 qts. of Milk,	**$282.67;**	**Profit per qt., 1.86 c.**
" " " Wholesaling 30,900 qts. of Milk,	**126.08;**	**" " 0.41 c.**
Total Profits from Sale of Milk for 139 Days,	**$408.75**	

Sixty-nine per cent., or more than two-thirds of the profits, were secured from the retail sales of milk. These sales amounted to 15,236 quarts only, or *thirty one per cent.* of the total production; CONSEQUENTLY, RETAILING MILK UNDER THE ABOVE CONDITIONS IS FROM FOUR TO FIVE TIMES AS PROFITABLE AS WHOLESALING.

II.

THE STUDY OF METHODS BY WHICH PROFITS MAY BE INCREASED.

The above conclusions indicate that the most obvious methods for increasing profits are:

1. *Retailing all milk produced.*
2. *Decreasing production expenses.*

1.

Profits may be Increased by Retailing all of the Milk Produced.

It has been shown that the profits from a herd of, approximately, thirty-five cows amounted, in one hundred and thirty-nine days, to $408 75, an average of two dollars and ninety-five cents daily. Of this amount, sixty-nine per cent., or two dollars and four cents, was gained from the retail sale of *one hundred and ten quarts*, leaving ninety-one cents only to represent the profits from wholesaling *two hundred and twenty two quarts. Fifty quarts sold at retail, therefore, would give the same profit as two hundred and twenty-two quarts sold at wholesale.* The cash balance, then, from the retail sale of the milk of seventeen cows, is equivalent to that from a herd of thirty-four cows so managed that one-third of its milk is retailed and two-thirds wholesaled; in other words, the profits are the same, although the amount of money invested in one herd is twice as large as that invested in the other.

Where milk, therefore, is the only profitable product from a herd, the rule should be *produce enough to supply retail demands only.*

One exception to this rule exists wherever large amounts of barnyard manure can be used with economy, that is, where a cash balance can be shown from a crop after the manure used has been charged at the prices ruling for plant-food.

Wherever fodder and feeds are credited to a farm and charged to its dairy herd, manure should be credited to the herd and charged to the farm. The following calculations will give approximately the quantity and value of the excrements from a herd of thirty-four cows for one hundred and thirty-nine days. The data for this calculation are as follows. They were secured by the Station upon Mr. James Neilson's farm, where unusually favorable conditions exist for work of this kind.

In this trial four cows were stalled upon a cemented floor from which loss by drainage was impossible. All fluid excrement was absorbed in air-dry peat which, previous to use, was analyzed and its percentages of nitrogen, phosphoric acid and potash carefully determined. A weighed quantity of this peat was placed in the cemented trench behind each cow, and was renewed twice daily; no straw or bedding of any kind was used.

The milk and excrements from each cow, as well as its food, were weighed and analyzed daily for four consecutive days, the precaution having been taken to feed these cows the experimental ration during the four days immediately preceding the trial.

The average weight of the excrement from each cow was sixty pounds per day; its average analysis was as follows:

Nitrogen.	Phosphoric Acid.	Potash.
.51 per cent.	.39 per cent.	.28 per cent.

The comparison of the ration used during the trial in Mr. Neilson's barn, with that fed upon the College farm during the one hundred and thirty-nine days already noted, indicates that the manure from the College farm herd must have been somewhat richer in nitrogen, phosphoric acid and potash than the above analysis indicated. Based upon these figures, however, the excrement from thirty-four cows for one hundred and thirty-nine days contained the following amounts of plant-food:

1,445 5 pounds of nitrogen, at 12 cents per pound	$173 46
1,105.4 pounds of phosphoric acid, at 6 cents per pound	66 32
793.6 pounds of potash, at 4½ cents per pound	33 73
Value of the herd manure for 139 days	$273 51

The total weight of excrement from thirty-four cows during one hundred and thirty-nine days, at sixty pounds per day per cow, would be one hundred and forty-one tons; in ordinary farming this would of course be increased by the straw used as bedding.

All expenses incurred in securing this manure and placing it in the cow-yard have been already charged against the herd—among the costs of milk production; hence, it follows that in addition to the cash balance of $108.75, received from milk sales, a profit of $273.51 exists in the plant-food voided by this herd during a period of one hundred and thirty-nine days.

As already stated, the cash balance would be the same if the milk from one herd of seventeen cows was retailed, while that of another herd of thirty-four cows was partly retailed and partly wholesaled; the total profits, however, would be in favor of the larger herd by $134.75; a balance to be found in the increased amount of plant-food voided by the larger number of cows.

The conclusions, therefore, are—

1. *Every effort should be made by farmers to secure a retail market for their milk.*
2. *It is rational to produce milk and sell it at wholesale at a trifling profit, whenever reasonable gains can be secured by the use of barn-yard manure.*

2.

Profits may be Increased by Reducing Production Expenses.

Production expenses may be reduced—

a. By using cheaper sources of food.
b. By properly regulating the amounts of feeds and fodders consumed by the herd.

In the preceding chapter of this report feeding systems are considered in detail, and fodders and feeds are shown to be *sources* of simply of digestible proteine, fat and carbhydrates. The following table will give the amounts of each of these elements consumed by a herd of, approximately, thirty-five cows, during one hundred and thirty-nine days:

	PERIOD I. JAN. 17TH, THROUGH MAR. 3D.				PERIOD II. MAR. 4TH, THROUGH APRIL 6TH.				PERIOD III. APRIL 7TH, THROUGH JUNE 3D.			
	Food consumed by herd.	CONTAINING POUNDS OF DIGESTIBLE—			Food consumed by herd.	CONTAINING POUNDS OF DIGESTIBLE—			Food consumed by herd.	CONTAINING POUNDS OF DIGESTIBLE—		
		Fat.	Proteine.	Carbhydrates.		Fat.	Proteine.	Carbhydrates.		Fat.	Proteine.	Carbhydrates.
Brewers' Grains	46,587	638	2,233.8	6,222.0	30,682	417.0	1,472.7	4,102.2	60,166	818.1	2,868.0	8,014.2
Corn Meal	7,311	243	508.0	4,655.7	5,038	167.3	350.0	3,204.6	7,926	262.3	548.4	5,026.7
Cotton Seed Meal	4,150	874	1,540.0	1,080.6	2,496	224.9	926.8	650.0	8,882	849.8	1,441.4	1,010.9
Linseed Meal	2,419	183.3	735.1	794.8	1,509	83.1	458.6	495.9	2,856	157.4	868.0	938.4
Wheat Chaff	2,428	9.2	25.7	811.2	2,175	8.8	23.1	728.2	2,875	10.9	30.5	962.5
Timothy Hay	2,640	24.0	96.9	1,207.5	2,656	24.2	97.5	1,214.9	4,241	38.6	155.6	1,928.4
Corn Ensilage	19,581	161.6	246.7	3,417.0	16,235	58.6	201.6	2,750.0	37,317	123.1	470.2	6,321.5
Clover Ensilage	1,020	6.7	28.8	188.6	2,340	15.4	66.0	318.0	....	....	....	....
Sorghum Ensilage	....	....	....	....	....	....	....	....	4,800	18.7	19.6	694.6
Dried Brewers' Grains	436	20.5	78.1	223.0	816	39.2	140.0	427.2	1,392	67.0	238.9	728.7
Dried Corn Stalks	670	4.2	19.6	378.2	484	3.2	14.1	270.0	272	1.7	7.9	151.5
Clover Hay	....	....	....	....	672	12.6	59.5	320.5	2,784	52.3	246.4	1,327.7
Total	....	1,612.5	5,507.7	18,823.6	....	1,018.9	3,812.9	14,481.5	....	1,900.1	6,914.9	27,135.1

a.

Production Expenses may be Reduced by using Cheaper Sources of Food.

It has also been shown in the preceding chapter, that milch cows require daily certain definite amounts of digestible fat, proteine and carbhydrates; the proteine and fat may be drawn from bran, grains, cotton seed or linseed meal, waste products from manufactories, while corn stalks and straw, farm wastes, may be used as sources of carbhydrates.

The above table furnishes data from which it may be calculated that 18 per cent. of the total fat, 12 per cent. of the total proteine and 30 per cent. of the total carbhydrates used by this herd were drawn from timothy hay, corn meal and clover hay, while only trifling quantities of stalks were used; in fact most of the stalks noted in the above table were eaten by cows which at that time were under the experiment published upon pages 122 and 123 of the last annual report of this Station. In this experiment it was proved that the milk yield was not increased when five pounds of corn meal were substituted for six pounds of corn stalks; it was also proved that neither of the rations then fed contained an excess of food. The conclusion reached was: "*The digestible carbhydrates in corn meal and corn stalks do not differ from each other in their effect upon the quantity of the milk produced.*"

By properly utilizing, therefore, all of the coarse fodders upon a farm, much of its hay and corn can be sold and milk and manure can be produced at increased profits.

b.

Production Expenses may be Reduced by Regulating the amounts of Food consumed by a Herd.

The last table gives the amounts of digestible fat, proteine and carbhydrates consumed by approximately 35 cows in 139 days. By summing up the number of days in this term upon which each cow was milked, the total for the first period was found to be 1,561; for the second period, 1,130, and for the third period, 2,033.

Fifteen hundred and thirty one, therefore, may be used either to represent the number of days which an average cow would require in order to consume this herd's feed and yield this herd's milk for the first period, or it may represent the number of average cows which would be needed to accomplish the same work in one day. The following table is based upon the latter supposition:

THE AVERAGE DAILY CONSUMPTION OF FOOD AND YIELD OF MILK PER COW.

PERIOD I. January 17th—March 3d.			PERIOD II. March 4th—April 6th.			PERIOD III. April 7th—June 3d.		
1,561 cows Consumed in one day			1,130 cows Consumed in one day			2,033 cows Consumed in one day		
Fat.	Proteine.	Carbhy-drates.	Fat.	Proteine.	Carbhy-drates.	Fat.	Proteine.	Carbhy-drates.
1,612.5	5,507.7	18,823.6	1,048.9	3,812.9	14,481.5	1,900.1	6,914.9	27,135.1
Therefore one cow consumed daily			Therefore one cow consumed daily			Therefore one cow consumed daily		
Fat.	Proteine.	Carbhy-drates.	Fat.	Proteine.	Carbhy-drates.	Fat.	Proteine.	Carbhy-drates.
1.03 lbs.	3.53 lbs.	12.06 lbs.	0.93 lbs.	3.37 lbs.	12.82 lbs.	0.93 lbs.	3.40 lbs.	13.35 lbs.
1,561 cows would yield in one day 14,222 quarts of milk.			1,130 cows would yield in one day 11,381 quarts of milk.			2,033 cows would yield in one day 23,363 quarts of milk.		
Therefore one cow would yield daily, 9.17 quarts.			Therefore one cow would yield daily 10.1 quarts.			Therefore one cow would yield daily 11.5 quarts.		

In the preceding chapter it has been shown that a cow of 1,000 lbs. live weight, when in full milk flow, requires daily, approximately—

Digestible Fat.	Digestible Proteine.	Digestible Carbhydrates.
0.50 lbs.	2.5 lbs.	12.5 lbs.

Professor Julius Kühn, a recognized authority on such subjects, places the limit of profit in feeding milch cows, per 1,000 lbs. of live weight, at

Digestible Fat.	Digestible Proteine.	Digestible Carbhydrates.
0.7 lbs.	2.7 lbs.	15 lbs.

The average weight of the cows in the College Farm herd at that time did not exceed 850 lbs. The average ration per cow, as calculated from the above table, was—

Digestible Fat.	Digestible Proteine.	Digestible Carbhydrates.
.96 lbs.	3.43 lbs.	12.74 lbs.

Recalculating this ration, upon the basis of 1,000 lbs. live weight per cow, gives the following:

Digestible Fat.	Digestible Proteine.	Digestible Carbhydrates.
1.13 lbs.	4.00 lbs.	15.00 lbs.

As regards carbhydrates, the College Farm ration agrees with Professor Kühn's maximum; in other respects, however, the differences are serious. Each cow, for instance, received daily 0.4 lbs. of digestible fat and 1.13 lbs. of digestible proteine *in excess of Professor Kühn's maximum;* for 34 cows, during 139 days, these differences would aggregate 1,890 lbs. of fat and 6,216 lbs. of proteine. In the cheapest source used in this experiment, viz., brewers' grains, digestible fat and proteine, each cost two and nine-tenth cents per pound; the lowest valuation, therefore, to place upon the above excess is $240. Much of this food, of course, fattened the cows, and some of it may have been sold profitably as beef, but the amount cannot be estimated even approximately. It is evident, however, that a very considerable saving can be effected in this department of herd management.

CONCLUSION.

It has been shown that this herd, managed in accordance with the views of practical dairymen, during a period of one hundred and thirty-nine days, yielded a cash profit of $408.75 from milk sales, and an additional profit of $273.51 invested in yard manure.

It has been shown that, if a retail market had been found for all of the milk actually sold during this period, the profit from these sales would have been increased to $857.41, while the amount invested in the manure would have remained unchanged; very large savings have also been indicated, both in the selection and use of feeding stuffs.

The conclusion, therefore, follows, that dairying can be made a very profitable department in farming, by obeying a manufacturer's rule, viz.: *find the best market and avoid all waste.*

REPORT OF MR. J. M. WHITE

UPON

PEACHES AND PEACH TREES

IN MORRIS, HUNTERDON AND SOMERSET COUNTIES.

In visiting the various peach growers in Morris and Hunterdon counties this season, I find ample proof that those who cultivate the most thoroughly and fertilize the most judiciously realize the greatest profits in peach growing. I find also, with a few exceptions, that the healthiest and longest lived orchards are those which have been fertilized with potash and phosphoric acid in some form, and those who have used these fertilizers are generally intending to try them again, while those who have only used yard manure or nothing are, in the majority of cases, looking for something better.

Mr. J. S. Quimby, of Chester, has 4,000 bearing trees 6 and 10 years old, nearly all of which are in healthy condition. He fertilizes with bone dust and wood ashes—using 500 pounds of bone to the acre and as much ashes as he can secure. His fruit has been abundant and of good quality, and his orchards promise fairly for another year. His practice has been to carefully select stock for planting, that there may be no diseased trees set in a new orchard; and in case any disease appears, every affected tree is removed and destroyed at once, and he is careful that no instrument which has been used upon a diseased tree shall be used on a healthy one till it has been thoroughly cleansed.

Mr. Quimby's land, upon which his orchards are planted, is high and sloping and well drained, the soil being gray rock with clay subsoil. He cultivates well, planting corn in his orchards for the first two seasons.

Mr. S. H. Wortman, of Pottersville, has about 7,000 bearing trees, from which he received the past season 3,600 baskets of peaches. His land is high and sloping, the soil being a gray rock with clay bottom and well adapted to peaches; he fertilizes very little and cultivates about twice in the season. His trees are 8 and 9 years old and not remarkably healthy, and he has considerable forced fruit.

E. Emmons, of Chester, has about 5,000 trees 4 and 5 years old; used some phosphate this season but does not know of what brand. The land is rather low and the trees are looking badly, being affected with yellows, which is attributed by the owner to the stock being diseased when set out.

J. L. K. Watters, of Sidney, Hunterdon county, has 7,500 bearing trees, nearly all being in a healthy condition and promising well for the future. His land is rather loamy, high and rolling, with clay subsoil, and he cultivates well. This is the second season he has used muriate of potash and bone with satisfaction, but is now of the opinion that he could have used more with profit, and will fertilize with the same another season.

Edwin Melick, of Clinton, has about 2,700 bearing trees 6 years old, which have given him 2 crops of fine fruit. He has used Mapes' potash bone for 2 years with satisfactory results and proposes to use it another season. His cultivation is thorough, and he is very careful to remove every tree as soon as there is any indication of disease in it. He has a sandstone soil with clay bottom. Under his treatment he has very little forced fruit.

Dr. Henry Race, of Pittstown, reports a large crop this season, having gathered 5,100 baskets of peaches from 3,000 trees, but thinks his fruit would have been better if it had been thinner upon the trees. This season he used muriate of potash with vitriolized bone, pound for pound, but will another season use more bone and less potash. His trees are looking well, and the promise for the future is good. This is the fifth year he has used potash in some form upon his orchard. Any further report from him would be about the same as last season.

W. J. Case, of Pittstown, who has usually been very successful, reports nearly a failure in crop this year. His trees bloomed full but afterward were affected with leaf blight and dropping of fruit, which he attributes to cold winds during the spring. His trees are now apparently healthy and promise well for another season. His treatment is the same as reported last season.

J. L. Nixon, of Quakertown, has 12,000 trees from 5 to 10 years old, and he gathered from them this season 9,000 baskets of peaches, which were sold at an average of $1.05 per basket. His soil is a sandy loam, gently sloping. He cultivates well—mostly with a spring-tooth harrow, and fertilizes with stable manure and wood ashes. Mr. Nixon raises his own stock for planting, using pits from natural fruit and buds from healthy trees. His orchards are apparently in a healthy condition.

S. K. Everett, of Cherryville, one year ago sowed clover in his twelve-year-old orchard where he had used muriate of potash and bone for four years. This season he plowed under the clover sod and applied lime. This orchard has put out a fine new growth of wood and promises well for another season. He is still satisfied with potash and bone.

R. Thatcher, of Flemington, has 3,500 bearing trees 6 and 9 years old, from which he gathered the past season 3,000 baskets of fine fruit that averaged over a dollar a basket. His soil is a gravelly blue shell with clay subsoil, and the trees are healthy. He fertilizes with yard manure—of which he has an abundance—applying it any time during the winter. He cultivates well, commencing as soon in the spring as the ground will work well, using the plow at first and afterward a spring-tooth harrow. He is careful to select stock without disease for planting, and should any disease appear the unhealthy tree is destroyed at once.

Henry S. Brown, of Quakertown, has 5,000 bearing trees, a part of which are 8 to 10 years old and looking fairly well. He has used yard manure as a fertilizer, but contemplates trying something else. His cultivation is very thorough, and his practice is to carefully select stock for planting, and then should any tree show signs of disease it is at once removed from the orchard. His soil is a clay loam, well drained and well adapted to peaches.

Observation leads to the belief that many cultivators do not rightly discriminate between the "yellows" and the effect of the borer, and many times attribute the effects of the one to the other.

Some of the sure indications of "yellows" are the dying of the twigs, a rough prickly bark along the limbs, premature ripening of the fruit, which usually has a red flesh and bitter taste.

The borer's work is usually shown by a gummy substance at the base of the tree at the surface of the ground, and yellow leaves when their work is carried to any extent.

REPORT OF MR. E. WILLIAMS

UPON

VINEYARDS

IN ATLANTIC, CAMDEN, CUMBERLAND AND ESSEX COUNTIES.

Valentine P. Hoffmann, Egg Harbor, N. J., has two vineyards planted seven or eight years. No. 1, soil, light; subsoil, heavy. It was under cultivation prior to planting the vines, some of which would leave out in winter. He had to replant a number of years before getting a permanent stand. It had not as good surface-drainage as No. 2. Stable manure was applied to the vines at planting; both pieces were trenched 18 inches deep. No. 2 was original scrub, the turf, stumps and bush being buried in the bottom of the trenches. Subsoil, heavy clay. Applied in 1884 a fertilizer formula furnished by Prof. Cook, of superphosphate (from bone black), kainit and cotton seed meal, equal parts of each, about 500 pounds per acre; vines 5 by 6 feet. No. 1 did the best up to the time of applying the fertilizer. In preparing No. 1 he saved a lot of the turf and composted it with lime. This, being well rotted, was applied to No. 1 in 1885, with good results, even better than the special fertilizer applied to No. 2. Rot has prevailed in both vineyards from year to year since coming into bearing. Less rot in 1884 than previous year, and still less in 1885; this is the general experience. It appeared later in 1885 than usual; very little mildew in 1885.

Of the first crop in 1880, about three-fourths rotted. This trouble has decreased yearly since; the last the most favorable yet known.

The principal varieties grown are Concord, Ives, Norton's Virginia, Taylor and Franklin. The Concord and its class rot the worst. The others are very little troubled with rot. Trains to stakes, as is the universal custom in the settlement; 5 pounds to the vine he considered a good average yield. Almost the entire crop of the settlement is made into wine. The prices realized for the fruit last season were from 2¼ to 2½ cents per pound for Concords; 3 cents for the Aestivalis and Cordifolia species, and 4 cents for white varieties.

Philip Steigauf, Egg Harbor, N. J., has about an acre in vineyard. Vines 5 by 6 feet, 12 years planted. Varieties, Nortons, Virginia, Clevenor, Concord, Ives, Missouri Reisling, Martha, Elvira, Lady Diogenes, Venango, &c. Soil, sandy loam, nearly level; subsoil similar, little clay. Ground trenched and leather chips put under the vines when planted, with little or no perceptible benefit. Has used bone-dust for two years past, also the phosphate, kainit, and cotton seed meal prescribed by Prof. Cook. This formula showed good results in 1884, though applied late. Its effect was also visible in 1885. Had used liquid manure on some vines and saw a vast difference in their appearance for two years afterward. Rot very bad some years. Last year very little, and mostly confined to the Concord, about one-quarter rotting; it appeared about the last of June. Has tried sulphur with no good effect visible; 5 to 10 pounds a fair yield per vine; keeps the ground clean with plow and cultivator. Blackberries at 7 cents per quart are better than grapes at 2 and 3 cents per pound.

George Freitag, Egg Harbor, N. J., has about 5 acres in vines, planted 5 by 6 feet. Commenced in 1869 with Concord and Ives; these, with Clinton, Norton and Clevenor, are his leading kinds. Soil, dry, the surface-water being carried off by ditches. Subsoil, gravelly loam. Soil trenched; stumps and brush filled in the bottom. Stable manure used to some extent. In 1884 used common salt and kainit as an experiment; found the kainit had the best effect. In 1864 a piece of ground was planted with vines, set in small holes, with bone dust about the roots. These vines soon reached the limits of the holes, and failing to penetrate the surrounding hard subsoil, many died. He afterwards purchased the ground, and finding the cause of failure, broke up the ground deep, scattering the fertilizer that had been used about the vines, and found this treatment very beneficial. He sold last year 6,391 pounds of grapes and made 700 gallons of wine, one of which represents about 13 pounds of fruit.

Frederick Fiedler, Egg Harbor, N. J., has about one acre in vineyard, planted 5 by 6 feet; commenced in 1866, and kept increasing from year to year. Varieties, Concord, Ives, Clinton, Nortons, Cynthiana, Martha and Taylor. Newer varieties, Missouri Reisling, Noah and Humboldt. Rogers' Hybrids mostly discarded. Soil, light and heavy loam; subsoil, heavy clay; ground trenched two feet deep all over. Stable manure used at planting. First chemical fertilizer used in 1884, applying the Cook formula, 600 pounds to half an acre. Dissolved the bone-black with 1 gallon of sulphuric acid; saw a marked benefit right away. If he could get all the wood ashes he wanted he would ask for nothing else. Used the fertilizer because he knew the vines needed it. Mildew and rot follow a southeast wind and warm, moist weather. Thinks smoke is a preventive; vines near houses are less affected than those outside, unprotected; *vines well fertilized are more vigorous and yield better than others;* high training showed less mildew and rot than in field culture. Never had as much rot as some others; 5 to 6 pounds a fair average crop for a vine; crop last year about as good as usual. A dug well, 20 feet deep, failed; a driven one, 26 feet deep, gives a full supply.

Mrs. Hassenteufel, Egg Harbor, has nearly an acre 5 by 6 planted, 14 and 15 years. Varieties, Clevenor, Concord, Ives and Norton. Ground trenched 2 feet deep; stable manure used in the holes 18 inches deep, this covered with surface soil about 6 inches, and vines planted. They came into full bearing the fourth and fifth year. Had full crops for two or three years, then rot appeared, chiefly on Concord; for two or three years this variety nearly all rotted. Since then the rot has gradually decreased; last year it was very slight. Soil, sandy loam, with considerable gravel, surface drainage good. Ives and Norton little affected with rot. Tried sulphur for two years without noticeable effect. Has rot without mildew; does not fear the latter as much. It has been no serious trouble. Uses stable manure with other refuse of her place, yearly, by different methods. Has opened deep furrows or trenches, with plow, between the rows, covering the manure therein; now prefers to apply it directly to the vines, a forkful to each vine. Trains on stakes, as is the general custom; 10 to 15 pounds is a fair average crop per vine. Makes the whole crop into wine.

When the rot was bad, made only 180 to 200 gallons of wine a year. Last year had a good crop and made nearly 700 gallons. A gallon generally represents 14 to 15 pounds of grapes; some varieties require 18 pounds for a gallon. The ground was trenched deep, which broke up any crust that would have prevented the water from soaking away. The iron-pan, as it is called, is thought to be good for grapes, producing red wine, but should be well broken up. Uses all the ashes she makes, but has never tried any experiment to note its effect. Plows once a year toward the rows, then back again; lets the weeds and grass grow, and leaves them on the ground. Has summer-pruned, but saw no benefit from the practice.

"I think her vines looked full as well as any I saw. Trenching means inverting the soil wherever used."

John H. Bannihr, Egg Harbor, N. J., has about 4 acres in vineyard, 12 to 18 years planted, 5 by 5 feet apart; ground high, sloping, affording natural drainage; soil, heavy loam; is not troubled with mildew. Nitrogenous manures should be well decomposed before application. Fish guano and other strong-smelling manures, unless composted, imparted a bad taste to the juice, noticeable in the wine. Preferred Clevenor, Norton, Franklin and Ives, disliked the Concord. Did not approve of summer pruning. Plowed once or so, did not mind a growth of weeds as the fruit among them was of higher quality where well shaded. (?)

Dr. Reimann, Egg Harbor, N. J., has a vineyard of 1½ acres in town, and one of 2½ acres on his farm out of town. The home vineyard is nearly level; soil, sandy loam. The farm vineyard is rather hilly; stiff, heavy loam; varieties about the same as others; trains to stakes, as is the usual custom; plants vines 7½ feet each way; prefers this distance now, as they get more air. The home vineyard was originally Concords, planted 5 by 5; has been replanted to the greater distance; vines set in holes 2 by 2½ feet; prefers Clevenor, Norton, Diogenes, Cynthiana, &c., as they are more free from rot; has used compost of muck, lime, &c. Last fall applied 1,000 pounds kainit with 400 pounds Mapes' fine bone, broadcast, to the home vineyard; is an old chemist, and believes the vines need potash; left no vines without any to note results; does not experiment. Next time shall probably give the vines a compost, or some other form of fertilizer; thinks a variety is beneficial; plows in spring, and cultivates once or so afterwards.

John Schuster, Egg Harbor, N. J., has 3 acres in vineyard; originally the vines were planted 5 by 5 feet, which is too close; now plants 7 by 7 feet; and a new vineyard of Cynthiana, on an old Concord site, has been planted 7 by 12 feet; the older vineyards are ten and twelve years old; 5 to 6 pounds to the vine is a fair, general average crop. In 1875 took 2,000 pounds from 100 Concord vines, but this was exceptional. One lot was trenched, and vines set in holes 3 feet over; soil, sandy loam and gravelly; generally well-drained naturally; applied stable manure composted with lime, refuse grapes, &c., in the holes when planting; has since broadcasted it, and buried it in ditches opened for the purpose, but in future shall use it broadcast. Has tried the special fertilizers used by Dr. Reimann, kainit and bone, but it is too soon to see its effects yet. The chief rotting is with Concord; does not think, as some do, that summer pruning is conducive to rot; has tried it and could see no difference.

Charles Saalmann, Egg Harbor, N. J., has about 12 acres in vineyard, three to twenty-two years planted; ground trenched 2 feet deep; brush and turf buried in the bottom; prefers to plant now 5 by 8 feet; used rotted stable manure and 200 loads of rotted turf in the trenches before planting the vines; the stable manure was about one foot below the surface; rot first appeared about eight years ago; the loss has been from one-eighth to one-half the crop; rot has decreased of late years—last year none worth mentioning. In 1884 used Mapes' fruit and vine manure, half a ton to the acre, in April; cultivated it in; saw beneficial effects immediately; applied same amount in 1885; not so much rot in Concords where it was applied as where stable manure was used; soil, sandy loam; naturally well drained; subsoil ditto. Has 6 acres of Norton's, 1 of Ives, 2 of Clevenor, 1½ of Concord, with some Cynthiana, Diogenes, &c.; 8 pounds is an average crop for a vine, but has taken 22, 24 and 26 pounds from a vine of Ives. Has applied a bucketful of home-made ashes to a vine without apparent effect; vines summer-pruned rotted least. Over a series of years, vines summer-pruned have rotted less than others. Mildew serious only one year; none last year; 6,000 to 7,000 pounds per acre was his crop last year, besides which he bought 80,000 pounds; all made into wine.

Julius Hincke, Egg Harbor, N. J., has about 12 acres in vines about the house, and 6 acres elsewhere; 4 acres 23 years old, 4 acres 16 years old, the rest younger. Soil, light sandy; subsoil, iron pan and sand in places. No perceptible difference in vines. Soil 2 to 3 feet deep. The iron pan is 2 to 3 feet below the surface; thinks it beneficial to the wine; never used any commercial fertilizer; uses muck and peat composted with stable manure, well rotted; formerly used bone dust and lime, with no perceptible benefit. Rot has been very destructive, so much so as to lose almost the entire crop of Concords some years, but no other kinds; very little rot last year. Has used sulphur, with no benefit. Plows in spring and cultivates two or three times; thought it decreased the rot, but found a neighbor who cultivated as well as he did who had more rot than he had. The rot seems to go in streaks. Mildew formerly very bad, but since Catawba has been abandoned it has not been serious. His vines are planted 5 by 6, 8 by 8, 8 by 10 and 10 by 10; thinks the two last-mentioned distances the best. Finds the yield per acre full as much at the greater distance. Average crop per vine, taking all kinds, about 4 pounds; has had 20 pounds from a vine of Taylor. Overloading Concord vines is sure to induce rot. He prunes severely so as to get 4 to 6 pounds to the vine. Practices summer pruning; thinks it necessary. Plows in spring, and cultivates as often as necessary to keep the grass and weeds down. Last year's crop was about 35,000 pounds, all made into wine.

Dr. J. H. North, of Hammonton, N. J., has 6,000 to 7,000 vines planted 8 by 6 feet; soil, light; subsoil, ditto. Variety Concord, principally. Two thousand Ives, but does not think much of them. Vineyards, 3 to 12 years old. Has generally raised sweet potatoes between the rows, which were fertilized with barn-yard manure till the grapes needed the ground, and they got their feed from this supply.

Three years ago commenced the use of kainit; about 500 pounds per acre. Plows and cultivates through the season; trains to stakes. Prunes in February, and then lets them alone. Formerly summer-pruned, but had abandoned it. Thinks the kainit prevented the grapes from rotting. Vines to which it was applied did not rot near as much as others. Was induced to use kainit to kill cut worms, and thinks it valuable for all crops. Has no mildew. An average crop is 12 to 20 pounds per vine; supposed he had 5 or 6 tons last year. Thinks one ton of kainit per acre, which was applied by mistake, did no harm.

E. R. Sproulle, Hammonton, N. J., has about 1,000 vines 3 to 7 years old. Mostly Ives. Some Concord, Martha and Norton's Virginia; the latter for wine. Soil, sandy loam; gravelly subsoil. Ground trenched 2 feet deep; putting sod, turf, &c., in the bottom; the vines did well for a time. Thinks bone the best fertilizer. Has used muriate of potash and kainit with beneficial results. Is satisfied *potash has given greater vigor of growth and deeper color to the leaves.* Has planted 5 by 8, but prefers 8 by 8. Thinks a fair average crop about 6 pounds. Has had very little rot at any time. Sometimes it has swept off the whole crop of some vineyards. Has no theory as to why he has been exempt in this respect. Thinks summer pruning is very beneficial.

J. O. Ransom, Hammonton, N. J., has 10 acres in vines 6 to 12 years planted; his present practice is to plant 8 by 8, so as to cultivate both ways. Varieties, Champion, Ives and Concord chiefly. The latter has rotted so badly he has dug up acres and replanted with Ives. Generally plants on new ground. Has trial vines of all the popular varieties. Thinks bone is the best fertilizer, if a good article can be had. An average crop per vine, 3 to 4 pounds (the lowest yet named). On new ground vines will do better for a number of years. Soil, light; trains to stakes; cultivates both ways with plow till last of June; plows away from the vines first, then towards them and cultivates. Lime and ashes good for grapes. Rose bugs very destructive; more on heavy than on light soil. He wants help for the rose bugs.

L. H. Parkhurst, Hammonton, N. J., has about 8 acres in vines, 4 to 12 years, planted 8 by 8 feet; soil, sandy loam; subsoil, stiff gravel; presumes water would stand in the hardpan, which is about two feet below the surface. Used bone at planting and chiefly since. Other crops among them while young were manured with other matter. His experiments with fertilizers on grapes will not enable him to give any perceptible results. Uses about 500 pounds of bone per acre on grapes, year after year; trains on stakes; plows twice; cultivates afterwards. Grows Ives mostly; prunes in winter and lets them go; has no doubt but summer pruning makes them later; average crop, 7 to 8 pounds per vine; very little rot; some trouble with rust on the leaves. Rose bugs very bad; picked them off in 1884 at an expense of $300; in 1885 this work cost $60 to $70; 1,200 pounds of bone, 200 pounds muriate of potash and 200 pounds nitrate of soda, composted, applied to strawberries, had done well. Used a complete manure formulated by the Fruit-Growers' Union, last year on blackberries, applying it to five rows and omitting one over the whole field of 5 acres; the rows treated could be seen distinctly over the whole field by the growth of crab grass; the plants were much more vigorous, and now promise much better for another crop. Applied 600 to 700 pounds per acre. Effect visible the whole season from the start.

Charles Beck, Vineland, N. J., has 3,000 vines, planted 8 by 9 and 9 by 9, 12 years old; chiefly Concord and Clinton. Average crop, 5 to 6 pounds per vine; 100 gallons of wine per acre. Made 600 gallons the last season. Thinks there was 400,000 gallons made in Vineland last year. Had been troubled with rot, but could not see any difference between young and old vines in this respect; neither could he account for the rot. Had no mildew last season, but very bad sometimes. For nine years before 1880 the rot was so bad the fruit did not pay for tying up the vines; for the past four or five years had had very fair crops. In 1883, 1884 and 1885 used marl, lime, &c.; previously cultivated carrots, cabbage, &c., among the vines, and, manuring these well, the vines were benefited and grew well. Thinks lime and marl good; full as good as other manures. Has not tried any special fertilizer. Trains to stakes, as usual.

David Reustle, Vineland, N. J., has 7,000 vines, mostly Concords, a few Ives and Clintons, planted 5 by 10 and 8 by 10 feet. Average crop, 9 to 10 pounds per vine. Uses stable manure; plants nothing without manure. Vines 10 to 12 years old. Thinks the best wine is made from mixed grapes. Made 1,800 gallons of wine last season and sold about 1,000 pounds of grapes. The rot took most all the crop formerly. Manures year after year, and does not believe it makes any difference in regard to rotting. Prunes in winter only; does not believe in summer pruning; trains on stakes, as is customary; cultivates all summer; allows no weeds to grow. Sees no difference in the ripening of the crop, whether near the ground or high up.

Geo. B. Muhleisen, Vineland, N. J., has about 5,000 vines left; took out about 4,000 Concords, because they rotted so badly; now that the rot is decreasing, is sorry. Is now planting Ives and Ironclad. Old vines planted 15 years, 8 by 8 feet; average crop of Concord, 10 pounds per vine; some vines yield 30 to 40 pounds. People who shipped Ives to market, spoiled the whole market; people who bought them had no more appetite for grapes. His vines about the house were planted 6 by 6 feet; had no rot in 1884 or 1885; thought where further apart they rotted as bad, if not worse. Had another vineyard of same age, no difference in treatment, all rotted down last year; both well drained, soil the same. The outside row had double the amount of grapes; roots ran 12 feet out in the road; vines were vigorous. Rotting looks as though the vigor had something to do with it. Will try one experiment by scraping all leaves and rotten stuff away, cover and spread lime on it. Trains on stakes; tried trellis, did not like it, could not cultivate both ways. No mildew last year; full crops fourth and fifth years, after that they rotted; overcropping, they did not get ripe. Had no rot till the thrips came. Never manured them yet since planting; will this year, and see which will be best. Believes *the best grapes are to be had where the most manure was used.*

Mr. James Green, Vineland, N. J., has a vineyard of 900 vines, all Concords but 75 Clintons. Planted 8 by 9 feet, 6 to 12 years old, sandy soil; 10 pounds per vine would be fair a average crop. No rot last year, some years nearly all have rotted. Plows, and buries all leaves and rubbish, and thinks it beneficial. Uses a good bit of lime, about 50 bushels per acre. Had used bone, but could not say if he received any benefit, as grapes all rotted. Summer-pruned two or three times; thinks it a benefit, at least sees no injury from this practice. No mildew of late years. Has no vineyards nearer than a quarter to half a mile. Thinks the younger the vine the less the rot. Cultivated continually to kill the sand-burrs, otherwise would not cultivate so often; would plow, turning under the manure, fallen leaves, &c., and then let it alone.

Query.—Has his isolation any relation to his exemption from rot?

Mr. John Anderson, Vineland, N. J., has 10 acres in vines, four to eighteen years old, 7 by 8, 8 by 12, 10 by 10 feet; prefers the latter distance; soil, sandy; well drained; subsoil, stiff sand and gravel; no special preparation of soil for the older vines; used about one and one-half barrels of bone per acre; used lime since, about twenty-five bushels per acre, with good results; did not have rot as soon as his neighbors by two years; then he had it as bad as they; always had a good crop of grapes when his neighbors failed; could not tell why, unless it was due to his system of raking in and covering with the plow all fallen leaves and rubbish on the ground; has done this about nine years. Grows Concords and Ives chiefly; does not treat his Ives in this way, as they are less liable to rot; Concords are plowed in spring, and the ground left undisturbed afterwards; to cover the fungus on the berries and the leaves, &c., as a fertilizer induced him to adopt this plan; 15 pounds was an average yield for

Concord vines; a new vineyard of Ives planted 10 by 10 and 3 feet deep, the vines planted in the bottom with about two quarts of bone; the holes were gradually filled during the summer as the weeds grew; was awarded the first premium last fall by the Vineland Fair Association. The average yield was estimated at 20 pounds per vine. This is so much of a departure from the generally accepted theory and practice in planting, it is an excellent subject for future study and observation.

Henry Raisch, Vineland, N. J., has 3,000 vines—2,000 Concords, 800 Ives, 200 Hartfords—seven to fifteen years, planted 8 by 8, 8 by 10 and 10 by 10; the last distance preferred; soil, light sandy loam; subsoil, dry; 10 to 12 pounds an average yield for a vine in maturity; trains to stakes; cultivates both ways through the season; has lost about one-half the crop of Concords on low ground, while on the high ground there was very little rot, comparatively; ground very poor; used all the barnyard and chicken manure he had, and, wherever used, it showed a decided benefit. And he has observed that *wherever the most manure was used these vines and grapes were the best with the least rot.* This had been his observation in his whole neighborhood; thinks lime is very good for grapes, twenty-five to thirty bushels per acre. A neighbor used lime for rose bugs, and found it beneficial to the grapes; finds spiders destroy a great many rose bugs, and regards them as friends of the grape grower.

Charles R. Snell, Vineland, N. J., has 5,000 vines, mostly Ives; 700 Champion; planted 5 by 10 feet; average crop per vine, 10 to 20 pounds; crop last season, about 14 tons; soil, sandy loam, about 18 inches deep; subsoil, hard, not very porous, 2 feet thick; lets off the water gradually; water about 11 feet below the surface.

Uses stable manure wholly. The rot was very bad formerly, so he got but a ton of grapes off the place in a season; it was now growing less. Close pruning and *high manuring,* he thinks, *gives less rot.* The Champion rotted one year to the extent of half the crop. Ives the healthiest of anything he has. If commencing now, would plant one-half Iron Clad for wine, Champion for market. Trains on a single wire 2½ feet high. Spur prunes. Cultivates clean. Made 1,250 to 1,500 gallons of wine last season. Has vines planted in his pear orchard. The trees have blighted so badly he wishes he had not a tree on his place.

A. W. Pearson, Vineland, N. J., has about 9,000 vines; 3,000

Concord, 2,000 Ives, balance Iron Clad and a few others; 4 to 18 years old; planted 6 by 9, which is too close; they ought to be 8 by 10. Soil, sandy loam; subsoil, red gravel, naturally well drained; trains on trellis of one wire, 2½ feet from the ground; prunes to short spurs, and frequent renewal; 15 to 20 pounds per vine, fair average crop for past two years. The rot has been subsiding for the past two years; very slight last year; formerly, some years the crop was a total loss. The past few years has practiced covering all leaves and decayed berries with the plow in spring, not disturbing them afterwards, and finds vines thus treated are practically exempt from rot, while those cultivated through the season have been badly affected. Has tried most of the so-called remedies for rot and mildew, but none promise as well as the above treatment. He has probably given these subjects more thought, study and attention than any one in the State. In the pursuit of these studies he has had access to all the French literature on the subject, and has had the assistance of Dr. Bidwell, a microscopist, and Dr. Brewer, a botanist, pursuing their investigations jointly for some years.

He finds the *vines most liberally fertilized are not only the most vigorous, but the least affected with mildew and rot.*

The outside rows that can forage for feed outside of the vineyard are invariably the most vigorous, productive and healthiest. As to fertilizers, he uses 25 to 50 bushels of lime, 300 pounds muriate of potash, 1,000 pounds of bone, applied every two years, and all other fertilizers he can obtain.

John W. Potts, Merchantville, N. J., has 5 acres in grapes; leading varieties, Concord, Christine or Telegraph, Agawam, Merrimac, Martha, Lady Goethe, Pocklington, Salem, Dracot Amber and Black Defiance. Plants in rows 9 feet apart; vines 16 and 20 feet apart in the rows; 4 to 20 years planted; trains on trellis of 2 wires; average yield, 25 pounds per vine; soil, light, sandy loam; subsoil, ditto. No standing water above or below. Has used no fertilizer to any extent. In 1884 he applied 2 tons of hair manure to Telegraph, Agawam, Merrimac and Goethe for mildew, with good effect; they were much better last year, producing a heavy crop of fruit and wood. Has used 6 bushels of common salt per acre, and saw a benefit in strength of foliage. Used whole bones under the vines at planting. Has used air-slaked lime on first appearance of mildew. Has had more or less rot ever since he commenced grape growing;

at the worst, lost one-half the crop. Martha has rotted as bad as any at times. Has no data as to time of rot appearing, or its cause. Mildew generally follows a hot, wet spell. Does no summer pruning, except to prevent the vines meeting between the rows. Plows in spring with two-horse plow towards the middle, using one horse next the rows; hoes out the rows where the plow will not reach. After awhile plows back again and cultivates to keep the weeds down. If the cultivator will not keep the weeds down, uses the plow. Took last season 1,000 pounds of grapes from two rows of 20 vines each. With the exception of the manure mentioned, has not used one-half a dozen cart loads on the whole vineyard since planting the vines. Thinks he will try kainit this season.

Wm. H. Goldsmith, of Newark, N. J., has 5 to 6 acres of vines 10 by 12 feet apart, planted from 4 to 23 years. Concord, Niagara, Brighton, Moore's Early, Duchess, Massasoit, Agawam, &c., &c. Soil, heavy loam; subsoil, hard red-sandstone formation, not very well situated for natural drainage; cannot work it under two days after a rain; mostly underdrained 25 to 50 feet apart and 3 feet deep, with board and tile; one of the former laid in his garden in 1849 was taken up two years ago and found to be as sound as when laid. Soil prepared as for ordinary crops for the vines; generally plant potatoes for two or three years, after setting the vines, and manuring them well, the grapes get the benefit. Uses stable manure broadcast, commercial fertilizer in drill. Has used bone and muriate of potash on the grapes but sees no special benefit from their use. Is better satisfied with a crop of two tons per acre than six tons as ordinarily grown. Has had rot at times bad, but so little last year as to upset all his preconceived views as to its cause and effect of remedies. There are several rots and mildews. Sulphur applied has hurt the foliage but not the mildew. Most rot on Concord and Duchess. Niagara rotted and mildewed in 1884 badly, very little in 1885, so that precautionary measures availed nothing.

William B. Ward, Newark, N. J., has about 3 acres in grapes, 8 by 10 feet; 4 to 12 years planted. Chiefly Concord and Duchess. Prunes in fall or early spring; trains on trellis of two wires; average yield about 20 pounds per vine. Soil naturally well drained, gravelly loam; subsoil, gravelly and hillside. Hardly a year passes without some rot; the last two years more rot than previously. In 1884 the Duchess entirely rotted. Has tried sulphur and lime for rot and mildew, but could not say he had seen any beneficial effects. Ground in good condition at time of planting, and applies well-rotted stable manure broadcast every spring and plows it in; has also used ground bone. Sees no material difference as to rot between vines well or poorly fed. A drain or overflow from his cow-yard was allowed to run down on the vineyard and had killed the vines within its reach; this indicates that too much of that kind of manure is detrimental. Has not experimented with any of the commercial fertilizers. Mr. Ward is within half a mile of Mr. Goldsmith, and both are about two and a half or three miles south of Newark.

Mr. John H. Vanness, of Hilton, N. J., has about 1,000 Concord vines, planted 4 to 6 years; average crop of the older vines, 20 to 30 pounds; vines 6 by 6 feet; manures annually with stable manure, cow-droppings comprising a large proportion of it, and plows it in. Has had some rot; last year very little. All his vines were heavily fertilized, hence could not note if poorly-fed vines exhibited any difference respecting the rot. Trains on trellises; vines spread fan-shaped.

NOTES ON

SWEET POTATO GROWING

IN VINELAND,

BY MR. A. P. ARNOLD.

Mr. Arnold has collected the following notes in regard to sweet potato culture in that part of Cumberland county. He thinks that they have not the sweet potato disease which has proved so damaging to Gloucester farmers. They have what they call the red rot and the black rot at times. The red rot shows itself soon after the plants are set. They turn of a reddish-yellow color and wither away, so that the whole fields are lost sometimes. This disease, he thinks, is in the plants, and contracted in the hot-beds. The black rot, he thinks, is in the seed, and by careful selection they get so as to have very little trouble with it. They are much troubled with a cut worm, which is very destructive. The past season out of a field of 90,000 full 45,000 were destroyed by this pest and had to be reset. They endeavor to avoid it by winter plowing and carbolic acid powder dissolved in water and put on the hills. A great many of their sweet potatoes are planted in rows between their vines and fruit trees. In open field culture they are set in hills 2 feet 9 inches apart each way —which makes about 5,500 hills to the acre. Potatoes are measured in baskets, each holding about 32 pounds, and 5 of them will fill a barrel. For fertilizer he uses 10 loads of barn-yard manure per acre, spread broadcast, and also a fertilizer made by mixing

1,000 S. C. Rock, dissolved,
500 pounds dissolved bone black,
200 pounds nitrate of soda,
100 pounds dried blood,
50 pounds sulphate of ammonia,
150 pounds muriate of potash;

or in place of this mixture Mapes' potato manure, using about 450 pounds of either per acre. The crop was a good one the past season, though he thinks it ran rather too much to vines. Considering this effect on the vines due to the nitrogen used, he will dispense with the use of nitrogen in his chemical manures next year, thinking the amount of that element in the barn-yard manure used to be sufficient for the crop.

The Tronnam Bros. have used Lister's potato manure and his standard phosphate, applying 1,200 pounds to the acre. They liked this better than stable manure. Their soil is a heavy, sandy loam. The crop was 125 bushels of potatoes of excellent quality.

Mr. H. R. Inglass used Yarnell's and Mapes' potato manure, 800 pounds per acre. The crop was very fine in size and quality on part of their land; on the other part the vines were too heavy and the potatoes not so good. The soil is a heavy, sandy loam.

Mr. Barcus used Mapes' potato manure, 300 pounds per acre. The potatoes were grown among his vines, and were of extra quality. He will use this altogether, instead of stable manure, hereafter. Soil, a heavy, sandy loam.

Moses Powell, of Vineland, has experimented with stable manure in comparison with commercial fertilizers this year, and the results are given in the statements following:

Three rows, 20 rods long, 39 inches apart, hills 25 inches apart in the rows, making 12 rods of ground.

1. Twenty large one-horse loads of good stable manure to the acre yielded

467	pounds large, or merchantable potatoes,
125	pounds seconds, or seed potatoes,
176	pounds small, or feed potatoes.
768	pounds, equals 205 bushels per acre.

2. No fertilizer.

63	pounds large potatoes,
81	pounds seed potatoes,
152	pounds feed potatoes.
296	pounds, equals 78 and four-fifths bushels per acre.

3. Fifty pounds Orchilla guano, sowed broadcast, to a row, (one ton of the guano per acre costing $25.)

155 pounds large potatoes,
121 pounds seed potatoes,
156 pounds feed potatoes.

432 pounds, equals 115 and one-fifth bushels per acre.

4. Orchilla guano, 1,200 pounds per acre, cost	$15 00
Muriate of potash, 200 pounds per acre, cost	4 30
Nitrate of soda, 110 pounds per acre, cost	23 70

296 pounds large potatoes,
137 pounds seed potatoes,
167 pounds feed potatoes.

600 pounds, equals 160 bushels per acre.

The fertilizers were sown broadcast. He began to set the plants in the stable manure, and so down the list as fast as the plants were large enough. Thus several days intervened between the first and last, which accounts for the decreasing yield.

J. B. Anderson used stable manure, Philadelphia street sweepings and Mapes' potato manure, side by side in the same field. The potatoes grown with the phosphates were far the best, and he will use the chemical fertilizers in growing this crop hereafter. His soil is a light, sandy loam.

George Davidson used 13 one-horse loads of stable manure and 300 pounds of J. P. Thomas' phosphate per acre, mixed. He thought that nearly one-fifth of his crop was ruined by cut worms, but he gathered 160 bushels of first quality potatoes on the acre. On a plot which he had manured for four years in succession with stable manure, the crop was very poor, except a few rows where he used phosphates, on which the potatoes were very good. He will use chemical manures altogether, instead of stable manures, hereafter. His soil is very light and sandy.

J. D. Heritage has used manure chiefly. He has tried Mapes' potato manure, and was much pleased with it. His potatoes were planted among his vines. Soil, heavy loam.

Frank Bingham, the largest sweet potato grower in the vicinity, mixed stable manure and muck for the most part. He has tried some phosphate and potash by the side of his manure compost, with about the same results. Soil, quite heavy, sandy loam.

C. H. Smith uses stable manure mostly. He has tried Mapes' potato manure, 600 to 700 pounds per acre. Those grown with the phosphate were better than the others. He is much pleased with the action of the chemical manures. Soil, heavy, sandy loam.

Charles Chalmers has used both stable manure and Mapes' potato manure. If there was any difference it was in favor of the phosphate. The potatoes were planted among his peach trees, in a very heavy soil.

L. Mortmer has raised sweet potatoes for a number of years with phosphates. This year 200 pounds of muriate of potash broadcasted, 400 pounds S. C. rock, and 400 pounds fine bone mixed, in the hill, per acre. The crop was very fine, and generally the potatoes were too large. He harvested 175 barrels of potatoes from 3 acres. He considers the phosphate much better and cheaper than stable manure, having used the chemical fertilizer three successive years with increasing yield of potatoes each year. His soil is sandy loam.

F. S. Newcome sowed 150 pounds of muriate of potash broadcast, and afterward applied the following mixture in the drill: 400 pounds S. C. rock, 100 pounds dissolved bone, 75 pounds sulphate of potash, 50 pounds nitrate of soda, 25 pounds sulphate of ammonia, 200 pounds raw bone, and 20 pounds nitrate of potash. He harvested 180 bushels of extra fine potatoes per acre. He has used some manure, but would purchase none at $1 or $1.50 a load.

CLOVER-SICK SOILS.

[The following was written in answer to a letter inquiring what could be done to give more certainty to the growth of clover, and to increase its yield.]

CLOVER.—There is much complaint among farmers, in all parts of the country where clover is grown, that the seed does not take as well as it did formerly, and that the crop is much more likely to fail than in former years. This failure of the clover crop has also become a serious damage to farmers in foreign countries. There it is attributed to the land having been cropped with clover till it is said to be *clover sick.* No certain cure for this condition of the soil has been found, though many experiments have been made. The most plausible hypothesis is that the soil and subsoil are exhausted of lime, magnesia, potash and soda, which are taken out of them in large quantities by the growing crop of clover. This is not proved to be the cause of the failure of the crop, but, in the absence of anything better, it would be well to consider it probable and make an experiment to test it. For this purpose the most convenient fertilizers to use would be kainit and plaster, as they would supply all the missing constituents mentioned. A mixture of the two fertilizers in equal quantities might be made, and 500 or 600 pounds of it used on an acre. It should be applied early in the spring, at the time of sowing the clover seed.

If such an experiment should be made, and the result reported to the Station, it would be useful, as it could be published for the benefit of others.

APPENDIX.

ACT OF INCORPORATION.

The New Jersey Agricultural Experiment Station was established by authority of the following acts of the Legislature of the State:

CHAPTER CVI.

AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF AN AGRICULTURAL EXPERIMENT STATION.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey,* That for the benefit of practical and scientific agriculture, and for the development of our unimproved lands, the New Jersey Agricultural Experiment Station, with suitable branches, is hereby established.

2. *And be it enacted,* That the direction and management of this institution shall be committed to a Board of Directors, which shall consist of the Governor of the State, the Board of Visitors of the State Agricultural College, together with the President and the Professor of Agriculture of that institution.

3. *And be it enacted,* That the members of this Board shall be called together by the Secretary of the Board of Visitors, and shall organize by the election of a President and Secretary, who shall hold their offices for one year, and until their successors are elected; five members shall constitute a quorum.

4. *And be it enacted,* That the Board of Directors shall hold a meeting each year, at Trenton, on the third Tuesday in January, and other meetings at the call of the President, at such times and places as may best promote the objects of the institution.

5. *And be it enacted,* That the Board of Directors shall locate said Experiment Station and branches, and shall appoint a Director,

who shall have the general management and oversight of the experiments and investigations necessary to carry out the objects of said institution, and shall employ competent chemists, and other assistants necessary to analyze soils, fertilizers and objects of agricultural interest, so as to properly carry on the work of the Station, and it shall make an annual report of its work to the Governor of the State.

6. *And be it enacted,* That a sum not exceeding five thousand dollars in any one year, is hereby appropriated to said New Jersey Experiment Station, which money shall be paid out from the State Treasury on the presentation of the bills of said Station, properly certified by the President and Secretary of the Board of Directors.

7. *And be it enacted,* That this act shall take effect immediately.

Approved March 10th, 1880.

CHAPTER LXXXI.

A SUPPLEMENT TO THE ACT ENTITLED "AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF AN AGRICULTURAL EXPERIMENT STATION," APPROVED MARCH TENTH, ONE THOUSAND EIGHT HUNDRED AND EIGHTY.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey,* That from and after the passage of this act, the Board of Directors, mentioned and created by said act, shall be called and known as the Board of Managers.

2. *And be it enacted,* That in addition to the powers now conferred upon said Board, they shall have power to elect a Treasurer, who shall hold his office for one year, and until his successor shall be elected and qualified; and to appoint such other officers and agents as may be necessary to carry on the business of the institution; and to make such rules, by-laws and regulations for the government of the Board, and for carrying out the objects, business and purposes of the institution, as may, in their judgment, be necessary and proper.

3. *And be it enacted,* That the annual appropriation for the support of the New Jersey Agricultural Experiment Station be and the same is hereby increased from its present sum of five thousand dollars a year to eight thousand dollars a year.

4. *And be it enacted,* That this act shall take effect immediately.

Approved March 9th, 1881.

CHAPTER CCVIII.

A SUPPLEMENT TO THE SUPPLEMENT TO AN ACT ENTITLED "AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF AN AGRICULTURAL EXPERIMENT STATION," APPROVED MARCH NINTH, ONE THOUSAND EIGHT HUNDRED AND EIGHTY-ONE.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey,* That section three of the supplement to the act entitled "An act to provide for the establishment of an Agricultural Experiment Station," be amended so as to read as follows:

3. *And be it enacted,* That the expenses of said station, when presented to the comptroller of the State, accompanied by the proper vouchers, duly certified by the President and Secretary of the Board of Directors, shall, upon warrant of said comptroller, be paid out of the State Treasury; provided, such expenses do not exceed the sum of eleven thousand dollars in any year.

2. *And be it enacted,* That this act shall take effect immediately.

Approved May 9th, 1884.

LAWS OF NEW JERSEY.

AN ACT TO REGULATE THE MANUFACTURE AND SALE OF FERTILIZERS.

1. That every commercial fertilizer which shall be offered for sale in this State shall be accompanied by an analysis, stating the percentage therein of ammonia, or its equivalent of nitrogen; of potash, in any form or combination, soluble in distilled water; and of phosphoric acid in any form or combination; the portion of phosphoric acid soluble in distilled water; that portion soluble in a neutral solution of citrate of ammonia at a temperature not exceeding one hundred degrees Fahrenheit; and that portion of phosphoric acid not soluble in either of the above-named fluids, shall each be determined separately; and the material from which the phosphoric acid is obtained shall also be stated; a legible statement of such analysis shall accompany all packages or lots of over one hundred pounds, sold, offered or exposed for sale.

2. That the Chemist of the State Board of Agriculture shall be the Inspector of Fertilizers; it shall be his duty to analyze one or

more samples of every kind of commercial fertilizers coming within the provisions of this act, which may be offered for sale within the State, and of which he shall be informed.

3. That manufacturers, dealers, and all persons interested, may obtain an analysis by notifying the Chemist of the State Board of Agriculture, upon which notification he shall be authorized to analyze, at his discretion, samples selected by himself, and to furnish certified copies of such analysis to the persons on whose application they were made; and it shall also be his duty to report all such analyses to the State Board of Agriculture.

4. That the Chemist of the State Board of Agriculture shall receive for each certificate of analysis made by him a sum not to exceed fifteen dollars, to be paid by the person or persons applying therefor.

5. That any person selling, offering or exposing for sale any commercial fertilizer without the analysis required by the first section of this act, or with an analysis stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense.

Approved March 24th, 1874.

SUPPLEMENT.

SEC. 1. That the penalty or penalties prescribed in section five of that act may be sued for and recovered, in an action of debt, in any court of competent jurisdiction in this State, in the name of any person who will sue for the same, one-half thereof for his own use, and the other half to be paid to the county superintendent of public schools of the county in which such suit or suits shall be brought, for the use of the public schools in their county.

Approved March 31st, 1875.

A SUPPLEMENT TO AN ACT ENTITLED "AN ACT TO REGULATE THE MANUFACTURE AND SALE OF FERTILIZERS," APPROVED MARCH TWENTY-FOURTH, ONE THOUSAND EIGHT HUNDRED AND SEVENTY-FOUR.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey,* That the fifth section of the act to which this act is a supplement, which section now reads as follows:

"5. *And be it enacted,* That any person selling, offering or exposing for sale any commercial fertilizer without an analysis required by the first section of this act, or with an analysis stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense," be and the same is hereby amended so as to read as follows:

5. *And be it enacted,* That any person selling, offering or exposing for sale any commercial fertilizer without an analysis required by the first section of this act, or the act to which this act is a supplement, or with an analysis stating that the said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense: *provided further,* that the provisions of this section, or the act to which this act is a supplement, shall not apply to any manure sold at a price not exceeding one-half a cent per pound, nor to any imported guanos.

2. *And be it enacted,* That this act shall take effect immediately.

Approved March 27th, 1878.

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INSTRUCTIONS

For Taking Samples of Commercial Fertilizers for Analysis.

The sampling must be done with care so as to do no injustice either to the buyer or seller. Samples should only be taken from bags, barrels or packages which are in good condition, and have not been wet or exposed to the weather so as to become either damper or drier than they probably were when sent from the manufacturer. It is not desirable to sample lots of less than a half ton. In small lots a portion may be taken from each bag or barrel; in larger lots a portion may be taken from every fifth or tenth bag. In case the fertilizer is caked it can easily be crumbled fine again by tumbling the bags over thoroughly.

The sample is to be taken by the sampling tube, inserting it in the corner of the bag, or the head of the barrel, and pushing it through the center of the fertilizer for its whole length.

The sampling tube, which is a copper tube 1½ inches diameter and nearly 3 feet long, is so made that it can be entered empty into the fertilizer, and when in its place a slot can be opened for its whole length, and the fertilizer will fall into it; then it can be closed and drawn out and emptied. The quantity drawn out will be a fair average of all that is in the package. If samples are taken from several packages of the same brand they must be put together on a clean paper and carefully mixed, and the sample for analysis taken from this.

The sample drawn for analysis, which may be a quart, should be immediately put into a glass fruit jar and tightly closed so as not to lose or gain any weight from moisture. Mark the jar with proper label.

Note accurately on the accompanying Form for Description the brand of the fertilizer, the manufacturer's name and place of business, the name and location of the dealer, the analysis guaranteed and the price at which the fertilizer is sold; with any remarks on the condition of the stock and the way it is kept. Sign this and send it with the sample to the Station. The jars should be wrapped with paper and packed in baskets, boxes or crates, so as to insure safe carriage; marked "N. J. Agricultural Experiment Station, New Brunswick, N. J.," and sent by express.

FORM FOR DESCRIPTION OF SAMPLE FOR ANALYSIS.

The person sending samples to the Station for analysis without charge, will be provided with a Form like this for each sample, and must fill up every one of the blank particulars given, so as to make the description complete and definite, *and in every case write his signature, as indorsing the accuracy of it.* As there is much responsibility in taking fair average samples, such as will justly represent the manufacturer as well as the consumer, it is very important that every precaution be taken, so that in case of a suit at law the person signing the description can testify to its accuracy. The writing should be plain and legible. The filled-out form, if wrapped with the sample, will serve as a label. If any printed circular, pamphlet, analysis or statement accompanies the fertilizer, or is used in its sale, send a copy with the specimen.

1. *Brand of Fertilizer*..

2. *Name and address of Manufacturer*..

....

3. *Name and address of Dealer from whose stock this sample is taken*..

4. *Date of taking this sample*..

5. *Selling price per ton, hundred, bag or barrel*..............................

6. *Selling weight claimed for each package weighed*.........................

7. *Actual weights of packages opened*..

8. *Copy of analysis or guaranteed composition affixed to packages of this Fertilizer*..

....

....

....

9. *Signature of person taking sample*...

Name..

P. O. Address..

ORDER OF STATION WORK.

The largest portion of the Station work is in the Analysis of Fertilizers, Field Experiments, Feeding Experiments, with Analyses of Foods, Fodders, Milk, &c. To do these branches of work well, continuous and steady attention must be given to each of them while it is in progress, and other business has to be laid aside for the time. To make this necessary order of work as little disappointing as possible for those who desire work at the Station, we publish this statement of the subjects upon which we propose to work at the different periods of the year:

Feeding Experiments	January and February.
Analyses of Fertilizers	March to September 15th.
Field Experiments	April and May.
Field Experiments	Sept. 15th to Nov. 30th.
Annual Report	December.

Miscellaneous work of various kinds may arise to interfere with the perfect regularity of this plan, but for accomplishing the largest amount of work it will be necessary to adhere as closely to it as possible.

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OF THE

NEW JERSEY STATE

Agricultural Experiment Stati

FOR THE YEAR

1886.

TRENTON, N. J.:
THE JOHN L. MURPHY PUBLISHING CO., PRINTERS.
1887.

To his Excell

SIR—I ha

report of the

required by

March 10th,

year.

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TREASURER'S

James Neilson, in account with th
Experiment Station, January 1st, 188

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From State Treasurer.....................................

PAYMENTS.

Salaries and pay of chemists and assistants.........
Expenses of the Board of Managers..................
Stationery..
Printing...
Postage...
Telephone service..
Fuel and stoves...
Gas and water...
Laboratory expenses......................................
Field and feeding experiments.........................
Freight, express and cartage bills....................
Expenses collecting samples of fertilizers...........
Traveling expenses...
Rent ....
Miscellaneous and incidental expenses................

Respectfully s

J

The Auditing Committee of the Experi
the accounts of the Treasurer of said Sta

II. SORGHUM—*Continued.*

2. A Detailed Report of the Past Season's Work.
3. The Changes and Improvements Needed in Order to Increase Receipts and Diminish Expenses.
4. Financial Considerations.

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1. The Effects of Commercial Fertilizers.
2. The Number of Hills per Acre.
3. At what Stage in its Development Should Sorghum be Harvested?

III. FODDERS AND FEEDS.

1. Kinds of Fodders Analyzed this Year.
2. Lucern, or Alfalfa.
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IV. SPECIAL REPORT ON PEACH TREES AND PEACHES.

V. ANALYTICAL METHODS FOR THE DETERMINATION OF NITROGEN.

VI. APPENDIX.

1. Laws of Establishment of the Stations.
2. Laws Regulating the Manufacture and Sale of Fertilizers.
3. Instructions for Taking Samples for Analysis.
4. Form for Description of Samples for Analysis.
5. Order of Station Work.

The retail prices at which manufacturers sell their standard brands remain the same through successive years. It is easier to vary the stock used so as to meet the fluctuations of its market price than to change the standard price of the mixed fertilizer sold to the farmer. It is possibly for this reason that there appears to be greater variations in the valuation of the separate constituents of the fertilizers in the retail prices than there are in the wholesale. The comparison of the wholesale and retail prices shows a somewhat greater difference than in former years. It is, however, very irregular, as will be seen by reference to the tabulated statement.

The number of brands of fertilizers analyzed at the Station laboratory during the past year is:

Complete fertilizers	150
Incomplete fertilizers	120
Miscellaneous samples (including ground bones, dissolved bones, &c.)	33

It is gratifying to be able to report that no cases of clearly proved intentions to defraud by selling worthless fertilizers have been met with this year. A few cases in which gross ignorance is shown have been brought to the notice of the Station. The closeness with which the work of the Station is watched is apparent in the greater uniformity in composition which each brand continues to have, and in the closer approach it makes to its own guarantee. It is a source of strength to the Station, and of assurance to the farmers and manufacturers, that the samples are taken by citizens of such standing that their fairness is beyond question from either side.

An attempt has been made within the year by the American Fertilizer Association to have the valuations of fertilizers omitted from the published analyses sent out by the Experiment Stations. In our Bulletin XL., which was distributed in October, the farmers were invited to send to the Station their opinions upon the subject. A considerable number of letters were received in response to this, and they were unanimous in the belief that the valuations were useful, and that their publication should be continued. It is believed that the farmers of New Jersey desire the continuance of the valuations. The system upon which the valuations are made is fully explained in the report. In the fluctuations of the market the selling prices may somewhat from the valuations, but as the system is uniform a parison of the valuations published will at least show the rel values of different brands. The valuation does not profess to giv aid a fertilizer will furnish in growing a crop; that is its agricul value, which must be determined by the farmer himself, fron knowledge of his soils and the wants of his crops. But the valu does clear away some of the difficulties which beset the farm selecting what he needs for his crops and what he can omit fro purchases. In short, it will prepare the way for the intelligent fa to buy the unmixed fertilizers and to only use such as he knows bring him a profitable return in the crop grown by its use.

The work of the Station upon fertilizers is educational t farmers. Each year shows a larger number of them who are the analyses and valuations, not only to guide in their purchase also to enable them to judge which of the fertilizing elements c used to profit. The field experiments, and studies of them, plainly enough that there are cases in which fertilizers do not returns equal to their cost. But that is due to not adapting ferti to the soils and to the crops to be grown, and must be correcte the judgment of the farmer with his experience on his own and crops.

The field experiments open a wide ground for consideratio further experiment. The proper economy of rotations suited t soils and the markets is well shown in some of the experimen the College Farm. These were first begun to show the effect o several fertilizing elements upon the growth of various staple c without reference to their cost in market. In this case, the be to be derived from them were expected to be found in the instru given to farmers upon the fertilizers needed to favor the grow the different crops, and of those which were not needed for that pose. They have accomplished this end.

But it would not be profitable farm practice to continue the u fertilizers in this way throughout an entire rotation, and this is shown in the computations upon the cost of the fertilizers use the value of the crops produced for several years. It is one o important duties of an Experiment Station to ascertain what m profitable in routine farming, and what may be omitted wi injury, and then to publish faithfully the results and conclu reached.

The experiments upon the growing of sorghum, and the production of sugar from it, have cleared up some of the difficulties connected with the general subject. They have been made in large fields, and in the working sugar-house, so that they represent both scientific accuracy and practical work, and they corroborate the results of preceding seasons. In the face of a market in which the price of sugar is lower than ever before known, it could hardly be expected that a profitable business should be started at once. But lines of inquiry have been marked out along which economies may be effected, sufficient in amount to make the production of sorghum and sugar one of the regular objects of farming industry in New Jersey. The investigations of the year are given in detail, and reference is hereby made to them in the body of the report. It is sufficient to say that difficulties attending the establishment of this new industry, are by no means so great or so discouraging as those which at first surrounded the production of beet sugar. That has overcome all its discouragements, and now produces more than half of all the sugar that is consumed in the world, and there is good reason for believing that sorghum sugar will, in the future, largely replace the beet.

The experiments to show the effect of fertilizers upon the growth and productiveness of peach trees are successful, and are giving great encouragement to the cultivators as well as to the consumers of this luscious fruit. By the use of chemical fertilizers, especially of muriate of potash, the trees are now kept in healthy growth and in bearing condition for many years, in the very fields where formerly, without the use of fertilizers, the lives of the trees were limited to six or seven years. On unmanured soils the foliage of the trees turned yellow, great numbers of little suckers grew out on the branches, and the trees were said to have the "Yellows" and soon died. The good effect of fertilizers upon the failing trees is so marked that many cultivators of peach trees believe there is no such disease as the "Yellows," and that their early failure is simply due to lack of proper plant-food.

The experiments lead, too, to the inquiry whether many of the cases of plant and tree failure are not due to want of proper and sufficient nutriment, rather than to peculiar diseases. It is certain that thorough and complete fertilization enables plants and trees to thrive, where, in other circumstances, they dwindle out a sickly life.

Field experiments in these cases will necessarily need to be different.

They may be planned and directed from the laboratories of the Station, but they must be carried out on farms which represent the peculiarities of the various sections, and the tillage must be managed by men familiar with the working of the class of soils to be experimented on.

The field experiments described in this year's report are intended to be in this line, and they bring out several interesting points, but they are only the beginning of what must be carried out in detail over the whole State.

Waste products to be used for fertilizers have been further experimented upon this year, with satisfactory results.

Phosphoral and other phosphates have been subjects of study in field experiments this year. They do not prove the propriety of asking for any change of the State law regarding the analysis of fertilizers. The change which has been called for by those introducing new phosphates would be in the determination of phosphoric acid soluble in solutions of citrate of ammonia to put the temperature required at 150 deg. Fahr., instead of 100 deg. Fahr., as it now is.

The field experiments in different parts of the State are also bringing out plainly the need for carrying out carefully-planned experiments to test the capabilities and the wants of the soils in different sections of the State. Small as New Jersey is, it has within its bounds all the varieties of soils from the heaviest clays to the lightest sands, and from limestone, marl and alluvial soils which are inexhaustibly rich, to those which will not grow the first crop without fertilization. It has, too, the variable soils which originated with the glacial drift, and the uniform soils which have been formed by the decay of the rocks, upon which they lie. The climate, too, varies from the maritime to the inland; from winters at the north with ice two feet thick to those at the south without ice enough to fill ice-houses; and with summers at the north six weeks shorter than at the south. Under these conditions the farming and farm products vary widely.

The analyses of fodders which have been made in the laboratory during the last year are made in response to a want which is felt by many intelligent farmers. Modern farming requires that all the products of the land shall be turned to economic use. Stock must be kept in as large numbers as can be fed from the coarse and less marketable products of the farm. The best hay and bright straw of the farm find a ready market at prices above what they are worth for feeding cattle or sheep, while corn stalks, black grass, salt grass, coarse straw, &c., are frequently wasted, though they could be profitably used for feeding stock, and the addition of cheap waste products from the mills, the grain merchants, the breweries, the distilleries, and other markets, can be mixed with these coarse farm products so as to make a complete, cheap, palatable and nutritious ration for farm animals, and the study of these will have much to do with the profits of farming. The subjects of waste products and the computation of rations have been taken up in former reports. This year's work is represented by 81 samples of fodders alone, and the results have been averaged and compared with the results of similar work in this country and in Europe. The ash analyses have also been made, so that calculations of their value for manurial purposes can be made.

FERTILIZERS.

STATISTICS OF FERTILIZERS CONSUMED IN NEW JERSEY DU YEAR ENDING NOVEMBER 1ST, 1886.

These statistics were taken by manufacturers from their boo answer to requests made by this Station. The reports were in case returned on printed forms, of which the following is a copy:

SALES OF COMMERCIAL FERTILIZERS.

The following is a correct statement of the number of tons of the se classes of Commercial Fertilizers sold in New Jersey by ——— — during the year ending November 1st, 1886:

Number of tons of Complete Manure ....
" " Ammoniated Superphosphate without Potash (Dissolved Bone, &c.) ....
" " Ground Bone ....
" " Kainite ....
" " Muriate of Potash ....
" " Nitrogenous Matter ....
(*a*) Ammonium Sulphate.. ....
(*b*) Sodium Nitrate..
(*c*) Blood, Ammonite, &c..
Number of tons of Plain Superphosphates, including both Dissolved Bone Black and S. C. Acid Phosphate..............

Three firms, for business reasons, declined to make reports; sev neglected to answer the Station's letters, and forty made return sales which aggregate *thirty-eight thousand six hundred and seve eight tons*, divided as follows:

			1882.	1884.	1885.	1886.
Number of tons of		Complete Manure	15,941	21,894	22,421	24,493
"	"	Ammoniated Superphosphate without Potash (Dissolved Bone, &c.)	1,370	1,541	1,603	1,343
"	"	Ground Bone	2,509	3,172	2,237	2,338
"	"	Kainite	683	991	584	1,106
"	"	Muriate of Potash	144	291	331	255
"	"	Ammonite	719	783	250	*693
"	"	Ammonium Sulphate	76	54	55	21
"	"	Sodium Nitrate	26	40	17	24
"	"	Blood	244	1,581	263	....
"	"	Fish	228	228	....	....
"	"	Hair	248	574	434	728
"	"	Poudrette	3,450	10,200	6,000	5,000
"	"	Superphosphates, 30-40 per cent	562	....	....	....
"	"	Superphosphates, 11-18 per cent	3,963	5,315	....	....
"	"	Bone Black Superphosphate	....	....	2,488	594
"	"	S. C. Rock	....	....	1,124	2,078
Total			30,163	46,664	37,810	38,678

---

*The total number of tons, in 1886, under Ammonite, include both blood and fish, returns having been made, in many cases, without discrimination.

It is admitted that these statistics are incomplete, as they represent forty manufacturers only out of the sixty-one whose brands have this year been sampled in this State and analyzed by this Station.

This statistical work is carried out without legal authority, the data being secured only through the courtesy of those manufacturers who, year after year, at their own expense compile their reports in answer to direct requests.

The total tonnage for the year, viz., *thirty-eight thousand six hundred and seventy-eight*, falls considerably below the returns given by the railroad companies to Mr. A. de Ghequier, Secretary of the National Fertilizer Association, Baltimore, Md. These returns indicate that *forty-two thousand eight hundred and twenty-eight tons* were transported during the past year by the leading roads of New Jersey, but it is not known whether this includes stable manure, or whether much of this tonnage may not have gone into consumers' hands in neighboring States.

unchanged; kainite, however, has declined during the year by approximately *ten per cent.* Nitrate of soda *advanced twelve per cent.*, and sulphate of ammonia varied but little from its average price in 1885.

The total cash value of the reported sales of commercial fertilizers in this State during 1886 can be easily calculated from the data in the two preceding tables. Compared with the sales for previous years they are as follows:

Total value of fertilizers reported for 1882	$1,070,113 00
" " " " " " 1884	1,369,004 00
" " " " " " 1885	1,116,670 00
" " " " " " 1886	1,181,266 00

FERTILIZERS.

In this branch of its work the Station aims to assist farmers who are in search of information regarding the purchase and use of fertilizers.

Questions referring simply to the prices and quality of brands are discussed in the chapter on *Commercial Relations.* The effects which fertilizers may produce upon the quantity and quality of a crop are shown in a following chapter on Agricultural Relations.

I.

THE COMMERCIAL RELATIONS OF FERTILIZERS.

Their Market Prices.

The Sources and Quality of their Nitrogen, Phosphoric Acid and Potash.

Their Guaranteed Chemical Composition and Relative Commercial Values.

THE MARKET PRICES OF FERTILIZERS.

The following points bear either directly or indirectly upon the average retail prices of fertilizers in this State:

1. The average *wholesale* prices of nitrogen, phosphoric acid and potash, in the crude stock out of which merchantable fertilizers are made.

2. The average *retail* prices of nitrogen, phosphoric aci potash, in the crude stock out of which merchantable fertilize made.

3. The comparison between the average *wholesale* and *retail*] of nitrogen, phosphoric acid and potash in crude stock.

1.

THE WHOLESALE PRICES OF NITROGEN, PHOSPHORIC ACID POTASH IN THE CRUDE STOCK, FROM WHICH MERCHANT FERTILIZERS ARE MADE.

The weekly reports of the wholesale market, published by th *Paint and Drug Reporter*, are the sources of the following ave The quotations for both blood and ammonite were expressed in of ammonia; these quotations have been recalculated on the ass tion that a ton of these materials contains in each case fifteen *un* 300 pounds of potential ammonia.

WHOLESALE PRICE, PER TON, AT NEW YORK, DURING 1886.

MONTHS.	OF NITROGENOUS MATTER.								OF POTASH SALTS.				
	Nitrate of Soda.		Sulphate of Ammonia.		Azotine.		Dried Blood.		Muriate of Potash.		Kainite.		Dou ph Pota Ma
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Jan......	$50 00	$48 00	$63 00	$60 00	$35 25	$34 50	$34 80	$34 05	$35 00	$33 50	$8 00	$7 25	$22 8
Feb......	49 00	47 00	63 60	61 60	35 70	34 80	34 80	34 05	35 80	33 50	7 50	7 25	23 0
March..	51 80	49 60	65 60	64 60	36 60	35 85	37 20	36 45	40 00	33 50	7 93	7 37	24 8
April...	53 45	51 00	69 00	67 60	39 00	38 25	37 13	36 88	37 60	33 50	7 55	7 23	23 0
May	53 25	46 00	65 75	63 75	38 25	37 50	36 00	35 25	35 75	33 60	7 75	7 03	23 0
June....	50 60	42 00	60 80	59 40	36 45	35 70	34 80	34 05	34 20	33 10	7 33	6 90	22 4
July.....	48 80	45 20	61 00	59 00	36 00	35 25	35 48	34 85	34 00	33 00	7 25	6 75	22 0
Aug......	45 80	42 20	60 60	59 00	36 00	35 25	35 32	34 58	34 00	33 00	7 25	6 90	22 0
Sept.....	43 40	40 60	60 00	59 00	36 00	35 25	35 10	34 85	34 70	33 70	7 30	6 97	21 3
Oct.......	40 80	38 80	60 60	59 60	36 00	35 25	36 00	35 25	35 00	34 00	7 50	7 25	21 0
Nov......	40 00	38 00	61 20	60 00	36 00	35 25	35 25	34 50	34 75	33 75	7 50	7 13	21 0
Dec......	40 80	39 30	61 00	59 60	36 00	35 25	33 13	32 40	35 40	33 60	7 50	7 25	21 2

PHOSPHORIC ACID.

The wholesale prices of phosphoric acid seem to have remained unchanged throughout the year, the quotation for acid phosphate having invariably been from $12 to $15 per ton. The average analysis of eighteen samples examined at this Station is as follows:

Soluble Phosphoric Acid	9.57	per cent.
Reverted Phosphoric Acid	1.82	"
Insoluble Phosphoric Acid	3.71	"

At the average price of $13.50 per ton of acid phosphate, the wholesale prices per pound of phosphoric acid rule as follows:

	Cents.
Soluble	5.48
Reverted	5.48
Insoluble	1.37

NITROGEN AND POTASH.

Nitrate of Soda	Averages	16	per cent.	nitrogen.
Sulphate of Ammonia	"	20½	"	"
Dried Blood and Ammonite	"	12½	"	"
Muriate of Potash	"	50	"	potash.
Kainite	"	12½	"	"

Based upon these analyses the average wholesale prices per pound of nitrogen and potash were as follows:

MONTHS.		AVERAGE WHOLESALE COST PER POUND OF NITROGEN IN FORM OF—												AVERAGE WHOLESALE COST PER POUND OF POTASH IN—								
		NITRATE OF SODA.			SULPHATE OF AMMONIA.			AZOTINE.			DRIED BLOOD.			MURIATE OF POTASH.			KAINITE.			DOUBLE SULPHATE OF POTASH AND MAGNESIA.		
		1884.	1885.	1886.	1884.	1885.	1886.	1884.	1885.	1886.	1884.	1885.	1886.	1884.	1885.	1886.	1884.	1885.	1886.	1884.	1885.	1886.
January…… February…… March…………	Max……	14.6	14.0	15.7	16.0	15.9	15.6	13.9	13.4	14.5	13.5	12.9	14.4	3.4	3.6	3.7	3.3	3.5	3.1	……	……	4.7
	Min……	14.0	13.8	15.1	14.6	14.6	15.1	13.1	12.8	14.2	12.7	12.5	14.1	3.2	3.3	3.4	3.1	2.8	2.9	……	……	4.4
April………… May ………… June…………	Max……	14.1	14.0	16.4	15.2	15.9	15.9	13.8	13.6	15.4	14.1	14.1	14.6	3.5	3.7	3.6	3.3	4.1	3.0	……	……	4.6
	Min……	13.3	13.2	14.5	14.3	14.6	15.5	13.4	……	15.1	13.4	13.7	14.3	3.3	3.4	3.4	3.0	3.0	2.8	……	……	4.3
July………… August……… September……	Max……	14.3	14.7	14.4	14.9	15.4	14.8	13.5	13.6	14.6	13.5	13.8	14.3	3.5	3.5	3.4	3.0	2.9	2.9	……	……	4.4
	Min……	13.6	13.9	13.8	14.4	14.6	14.4	13.2	13.3	14.2	12.6	13.4	13.9	3.3	3.3	3.3	2.9	2.7	2.8	……	……	4.2
October……… November…… December……	Max……	14.1	15.8	12.7	15.7	15.2	14.9	13.0	13.7	14.6	12.9	14.1	14.1	3.4	3.5	3.5	2.6	3.2	3.0	……	……	4.2
	Min……	13.5	15.0	12.1	14.5	14.8	14.5	12.6	13.4	14.2	11.9	13.8	13.8	3.2	3.4	3.4	2.6	2.9	2.9	……	……	4.1
Yearly Averages.	Max……	14.3	14.6	14.8	15.5	15.6	15.6	13.6	13.6	14.8	13.5	13.7	14.4	3.5	3.6	3.6	3.1	3.4	3.0	……	……	4.5
	Min……	13.6	13.9	13.8	14.5	14.7	14.7	13.1	13.2	14.4	12.7	13.4	14.0	3.3	3.4	3.4	2.9	2.9	2.9	……	……	4.3

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THE COMPARISON BETWEEN THE AVERAGE WHOLESALE AND RETAIL PRICES OF NITROGEN, PHOSPHORIC ACID AND POTASH IN CRUDE STOCK.

The conclusions reached in Sections 1 and 2 are here tabulated. They represent the manufacturers' *wholesale* and *retail* prices for plant-food *in its best forms.* The percentages by which the retail prices exceed the wholesale, have been taken as the basis of the comparison.

	MANUFACTURERS' AVERAGES.		Average percentages by which the retail prices exceed the wholesale, 1886.	Average percentages by which the retail prices exceed the wholesale, 1885.
	Wholesale prices for 1886.	Retail prices for 1886.		
	cts.	cts.		
Nitrogen from Nitrate of Soda	14.3	18.2	27.3	12.5
" " Sulphate of Ammonia	15.1	18.1	19.9	9.86
" " Dried Blood	14.2	20.0	40.8	13.90
" " Dried Fish	....	16.6	....	....
" " Ammonite	14.6	16.6	13.7	20.19
Soluble Phosphoric Acid from Bone Black	....	7.8	....	....
" " " " S. C. Rock	5.48	7.4	35.0	51.24
Reverted " " " Bone Black	....	7.8	....	....
" " " " S. C. Rock	5.48	7.4	35.0	52.00
Insoluble " " " Bone Black	....	1.9	....	....
" " " " S. C. Rock	1.37	1.9	38.7	52.00
Potash from High-Grade Sulphate	....	5.8	....	....
" " Double Sulphates of Potash and Magnesia	4.3	6.5	51.2	51.00
" " Kainite	2.9	4.2	44.8	40.62
" " Muriate	3.5	4.0	14.3	17.14

In 1885 manufacturers retailed nitrogenous matter at prices from ten to twenty per cent. in advance of the average wholesale quotations; in 1886, however, their retail prices for the same materials were decidedly advanced, and ranged from fourteen to forty per cent. higher than the corresponding wholesale rates.

Phosphoric
price at retail
wholesale; las
cent.

Practically,
year exceeding
other cases by
year's market.

THE SOURCES

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siderable meat has been dried and ground with the bone.

As a rule, dealers have declined to give retail cash prices for tankage, claiming that a retail trade in it does not exist. The few quotations obtained indicate that it is a very cheap source of nitrogen, and therefore should be brought to the attention of consumers.

PHOSPHORIC ACID.

The superphosphates have been arranged with reference to the crude stock from which they are made; those from bone black and bone ash being in the first table, and those from South Carolina rock and similar mineral phosphates in the second.

An effort is now being made to increase the sales of so-called natural guanos in this State.

In some counties they are regarded with favor by consumers, and, consequently, their number increases from year to year. Five such samples are tabulated upon a subsequent page. Their sources are islands in the Caribbean sea, or in the Gulf of Mexico. This table also contains an analysis of phosphate meal from the Peine Thomas scoria, a product comparatively new in this country. This meal is a waste product from the steel works of Peine, in Germany. In rolling mills at this place a pig-iron rich in phosphorous is worked according to the Sidney Gilchrist Thomas patents. During this process the phosphorus is converted into phosphoric acid, which, combined with lime, is run out as slag; when the excess of caustic lime in this slag slakes a very finely divided product is secured, containing *twenty per cent.* of phosphoric acid.

Field experiments upon wheat and rye to determine the relative values of this scoria, as compared with that of several of the other insoluble phosphates in this table, are now in progress in different sections of this State under the immediate supervision of this Station.

POTASH SALTS.

The State law provides that in the analysis of fertilizers chemists shall determine only those forms of potash which dissolve in water; it ignores, therefore, greensand marl, and also certain forms of organic matter, both of which are sometimes used as sources of this element.

The "muriate," "kainite" and "double sulphate" are known salts from the German mines near Stassfurt. The tw mentioned are now frequently found in farmers' hands, but the prices demanded for small lots at retail exclude the double sul from the trade.

A new product, known as the high-grade sulphate, has rec been introduced. It contains potash equivalent to ninety-five per sulphate of potash, and, consequently, may prove very serviceal manufacturers who wish to use nitrogenous matters or phosphat low percentage composition in making up their standard fertili Four samples of this salt are tabulated upon a subsequent page.

FORMS OF NITROGEN

Readily and Completely Soluble in Water.

NITRATE OF SODA

FURNISHING

Nitrogen in Form of Nitrates.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Nitrogen.	Cost of Nitrogen per lb.	Cost of 2,000 lbs. of Nitrate of Soda.
			cts.	
1131	Mapes' Formula and Peruvian Guano Co.	16.12	16.6	*$53 50
1136	Lister Bros., Newark	15.80	18.2	57 50
1150	Geo. B. Forrester, New York	16.30	17.6	57 50
1156	H. J. Baker & Bro., New York	16.30	17.6	57 50
1171	Bowker Fertilizer Co., New York	16.29	19.9	65 00
1185	Williams, Clark & Co., New York	16.42	17.5	57 50
1210	M. L. Shoemaker & Co., Philadelphia	15.87	18.9	60 00
1221	Moro Phillips, Camden	16.42	....	....
1232	Sharpless & Carpenter, Philadelphia	15.80	19.0	60 00
1239	Baugh & Sons, Philadelphia	16.07	18.6	60 00
Average cost per pound of Nitrogen in Nitrate of Soda			18.2	....

SULPHATE OF AMMONIA

FURNISHING

Nitrogen in Form of Ammonia.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Nitrogen.	Cost of Nitrogen per lb.	Cost of 2,000 lbs. of Sulphate of Ammonia.
			cts.	
1132	Mapes' Formula and Peruvian Guano Co.	20.27	16.0	*$65 00
1137	Lister Bros., Newark	20.76	17.5	72 50
1151	Geo. B. Forrester, New York	21.06	17.2	72 50
1157	H. J. Baker & Bro., New York	20.76	18.9	77 50
1165	C. Meyer, Jr., Maspeth, L. I.	20.08	18.1	72 50
1166	C. Meyer, Jr., Maspeth, L. I.	17.89	19.7	70 00
1172	Bowker Fertilizer Co., New York	20.65	18.2	75 00
1194	Williams, Clark & Co., New York	20.29	17.7	72 00
1200	E. Frank Coe, New York	20.06	....	....
1211	M. L. Shoemaker & Co., Philadelphia	20.87	17.2	70 00
1233	Sharpless & Carpenter, Philadelphia	20.44	19.7	80 00
1240	Baugh & Sons, Philadelphia	20.03	18.7	75 00
Average cost per pound of Nitrogen in Sulphate of Ammonia			18.1	....

*Delivered, in car load lots, at Moorestown.

FORMS OF NITROGEN INSOLUBLE IN WA

FURNISHING

Nitrogen in Form of Organic Matter.

DRIED BLOOD.

Station No.	NAME AND ADDRESS OF DEALER.	Percentage of Nitrogen.	Cost of
			C
1149	Mapes' F. and P. Guano Co.	10.11	1
1175	Bowker Fertilizer Co.	10.02	2
1186	Williams, Clark & Co.	9.49	1
1189	Lister Bros.	14.26	....
Average cost per pound of Nitrogen in Dried Blood			2

AMMONITE, FISH AND CASTOR POMACE.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage.		Cost Per Pou	
		Nitrogen.	Phosphoric Acid.	Nitrogen.	Phosphoric
				cts.	c
1212	M. L. Shoemaker's Ammonite B	12.68	4.89	16.1	7.
1227	U. S. Chemical Co., Ammonite B	12.17	1.56	16.7	7.
1241	Baugh & Son's AA Nitrogen	10.50	8.68	19.0	7.
1176	Bowker's Dried Ground Fish	9.12	7.33	16.3	7.
1228	U. S. Chemical Co., Dried Ground Fish	8.61	6.81	11.9	7.
1248	Garrison & Minch, Dried Ground Fish	8.43	7.18	17.8	7.
1158	H. J. Baker & Bro., Castor Pomace	4.71	1.73	18.6	7.
Average cost per pound of Nitrogen				16.6	.....

TANKAGE AND SWIFT SURE GUANO.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage.		Cost Per Poun	
		Nitrogen.	Phosphoric Acid.	Nitrogen.	Phosphoric Acid
				cts.	cts
1188	Lister Bros., Tankage	7.88	8.00	....	....
1148	Mapes' F. and P. Guano Co., Tankage	6.55	14.26	....	....
1167	C. Meyer, Jr., Tankage	9.12	4.94	13.1	5.0
1174	Bowker's Fertilizer Co., Tankage	8.55	8.20	....	....
1195	John Taylor & Co., Hog Tankage	6.11	14.65	....	....
1196	John Taylor & Co., Beef Tankage	3.85	19.97	....	....
1197	John Taylor & Co., Hog Tankage	4.90	18.91	....	....
1208	E. Frank Coe, Tankage	8.19	17.02	....	....
1218	M. L. Shoemaker & Co., Swift Sure Guano	7.95	11.98	10.1	5.0
1234	Sharpless & Carpenter, Tankage	6.14	14.49	....	....
1178	Bowker's Fertilizer Co., Hoof Meal	15.11	0.18	....	....

PLAIN SUPERPHOSPHATES

Furnishing Soluble, Reverted and Insoluble Phosphoric Acid.

MANUFACTURED FROM

BONE BLACK, BONE ASH, &c., &c.

Station number.	BRAND.	MANUFACTURER OR WHOLESALER.	SAMPLED BY.
1134	Bone Black Superphosphate....	Mapes' F. and P. Guano Co., New York.	H. I. Budd, Mt. Holly.
1143	Bone Black Superphosphate....	Lister Brothers, Newark.	Chemist of Station.
1155	Bone Black Superphosphate....	George B. Forrester, New York.	Chemist of Station.
1164	Bone Black Superphosphate....	H. J. Baker & Bro., New York.	Chemist of Station.
1170	Bone Black Superphosphate....	C. Meyer, Jr., Maspeth, L. I.	Chemist of Station.
1181	Bone Black Superphosphate....	Bowker Fertilizer Co., New York.	Chemist of Station.
1192	Bone Black Superphosphate....	Williams, Clark & Co., New York.	Chemist of Station.
1206	Bone Black Superphosphate....	E. F. Coe, New York.	Chemist of Station.
1214	Bone Ash Superphosphate.......	M. L. Shoemaker & Co., Philadelphia.	Chemist of Station.
1215	Bone Black Superphosphate....	M. L. Shoemaker & Co., Philadelphia.	Chemist of Station.
1248	Bone Black Superphosphate....	Baugh & Son, Philadelphia.	Chemist of Station.
1328	Bone Black Superphosphate....	Bowker Fertilizer Co., New York.	J. M. White, New Brunswick.
1351	Bone Black Superphosphate....	Preston Fertilizer Co., Greenpoint, L. I.	H. I. Budd, Mt. Holly.
1374	High Grade Superphosphate...	Mapes' F. and P. Guano Co., New York.	Chemist of Station.

MINERAL PHOSPHATES, GROUND, NOT DISSOLVED.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
1127	Floats, Calcined........................	Tropic Guano Co., New York.	Chemist of Station.
1407	Carib Guano..............................	L. N. & J. S. Hopkins, Importers, Baltimore, Md.	I. W. Nicholson, Camden, N. J.
1414	Penguin Island Guano............	Charles Spear, Jr., Importer, New York.	J. M. White, New Brunswick, N. J.
1515	Orchilla Guano.........................	R. A. Wooldridge, Baltimore.	Theodore F. Baker, Bridgeton, N. J.
1596	Phosphate Meal........................	Paul Weidinger, New York.	Chemist of Station.
1605	Grand Cayman Island Guano..	N. B. Powter, New York.	Chemist of Station.

PLAIN SUPERPHO

Furnishing Soluble, Reverted and In

MANUFACTURED F

BONE BLACK, BONE A

Station number.	MANUFACTURER OR WHOLESALER.	Phosphor	
		Soluble in Water.	Soluble in Ammonium Citrate.
1134	Mapes' F. and P. Guano Co...	14.82	2.41
1143	Lister Bros.	17.48	0.17
1155	Geo. B. Forrester	16.42	0.85
1164	H. J. Baker & Bro.	17.82	0.68
1170	C. Meyer, Jr.	14.40	3.09
1192	Williams, Clark & Co	14.59	3.20
1206	E. F. Coe	14.40	3.08
1214	M. L. Shoemaker & Co	15.45	0.32
1215	M. L. Shoemaker & Co	14.80	0.81
1248	Baugh & Son	14.34	0.29
1328	Bowker Fertilizer Co	14.69	0.41
1351	Prestons Fertilizer Co	16.20	0.64
1374	Mapes' F. and P. Guano Co...	27.76	5.20

Average cost per pound of Phos. Acid from B

* Delivered in car-load lots at Moorestown.

MINERAL PHOSPHATES, GROUN

Station number.	
1127	Connetable Island Floats
1407	Carib Guano
1414	Penguin Island Guano
1515	Orchilla Guano
1596	Phosphate Meal from Peine Thomas Scoria
1605	Grand Cayman Island Guano

PLAIN SUPERPHOSPHATES

Furnishing Soluble, Reverted and Insoluble Phosphoric Acid.

MANUFACTURED FROM

SOUTH CAROLINA ROCK AND OTHER MINERAL PHOSPHATES.

Station number.	BRAND.	MANUFACTURER OR WHOLESALER.	SAMPLED BY.
1183	Acid Phosphate	Mapes' F. and P. Guano Co., New York.	H. I. Budd, Mt. Holly.
1163	Packard's High Grade Superphosphate.	H. J. Baker & Bro., New York.	Chemist of Station.
1180	Packard's High Grade Superphosphate.	Bowker Fertilizer Co., New York.	Chemist of Station.
1182	Acid Phosphate	Bowker Fertilizer Co., New York.	Chemist of Station.
1193	Acid Phosphate	Williams, Clark & Co., New York.	Chemist of Station.
1198	Acid Phosphate	Lord & Polk, Philadelphia.	A. P. Arnold and L. Mortimer, Vineland.
1205	Acid Phosphate	E. Frank Coe, New York.	Chemist of Station.
1216	Acid Phosphate	M. L. Shoemaker & Co., Philadelphia.	Chemist of Station.
1223	Acid Phosphate	Moro Phillips, Camden.	Chemist of Station.
1229	Philadelphia Standard	U. S. Chemical Co., Camden.	Chemist of Station.
1231	Acid Phosphate	N. J. Chemical Co., Camden.	Chemist of Station.
1238	Acid Phosphate	Sharpless & Carpenter, Philadelphia.	Chemist of Station.
1245	Acid Phosphate	Baugh & Son, Philadelphia.	Chemist of Station.
1375	Diamond Soluble Bone	Walton, Whann & Co., Wilmington.	J. H. Denise, Freehold.
1389	Acid Phosphate	Dambmann Bros. & Co., Baltimore.	J. M. White, New Brunswick.
1411	English Superphosphate	L. T. Derousse, Camden.	I. W. Nicholson, Camden.
1416	Acid Phosphate—New Process	J. J. Allen's Sons, Philadelphia.	H. I. Budd, Mt. Holly.
1435	Acid Phosphate	J. E. Tygert & Co., Philadelphia.	Theo. F. Baker, Bridgeton.

PLAIN SUPERPHOSPHATES

Furnishing Soluble, Reverted and Insoluble Phosphoric Acid.

MANUFACTURED FROM

SOUTH CAROLINA ROCK AND OTHER MINERAL PHOSPHATE

Station number.	MANUFACTURER.	Phosphoric Acid.				Cost Per Pound.		
		Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	"Available."	"Available" Phosphoric Acid.	Insoluble Phosphoric Acid.	
						cts.	cts.	
1133	Mapes' F. and P. Guano Co	9.79	2.63	3.56	12.42	6.51	1.63	*
1163	H. J. Baker & Bro	37.02	5.17	2.34	42.19	8.76	2.19	
1180	Bowker Fertilizer Co	42.53	2.84	0.45	45.37	7.96	1.99	
1182	Bowker Fertilizer Co	12.27	0.69	1.63	12.96	8.40	2.10	
1193	Williams, Clark & Co	9.70	0.94	4.41	10.64	7.00	1.75	
1198	Lord & Polk	7.91	2.45	6.15	10.36	6.40	1.60	
1205	E. Frank Coe	11.04	1.50	3.10	12.54	....	....	...
1216	M. L. Shoemaker & Co	12.29	0.74	0.92	13.03	7.56	1.89	
1228	Moro Phillips	9.31	2.24	3.84	11.55	....	....	...
1229	U. S. Chemical Co	9.12	2.64	3.83	11.76	6.68	1.67	
1231	New Jersey Chemical Co	10.46	2.07	3.46	12.53	7.48	1.87	
1238	Sharpless & Carpenter	7.95	1.55	3.29	9.50	6.92	1.73	
1245	Baugh & Sons	7.01	2.52	7.05	9.53	6.64	1.66	
1375	Walton, Whann & Co	6.83	4.05	5.27	10.88	9.40	2.35	‡
1389	Dambmann Bros. & Co	10.01	1.21	2.98	11.22	7.52	1.88	
1411	L. T. Derousse	12.33	0.57	1.15	12.90	5.68	1.42	
1416	J. J. Allen's Sons	8.35	1.90	1.82	10.25	7.96	1.99	
1485	J. E. Tygert & Co	8.87	1.37	2.89	10.24	7.76	1.94	
Average Cost per pound of Phos. Acid from S. C. Rock						7.41	1.85	....

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*Delivered in car-load lots at Moorestown. †Delivered in car-load lots at Vine

‡Retail price per ton at Freehold.

GERMAN POTASH SALTS.

HIGH GRADE

Sulphate and "Bi-Sulphate" of Potash.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Potash.	Cost of Potash per pound.	Cost of 2,000 pounds of the High Grade Sulphate.
			cts.	
1146	Mapes' High Grade Sulphate	51.30	....	....
1152	Forrester's "Bi-Sulphate of Potash"	35.54	6.0	$42 50
1189	Williams, Clark & Co., High Grade Sulphate	48.45	6.2	60 00
1220	Shoemaker's High Grade Sulphate	52.06	5.3	55 00
1226	Moro Phillips' "Bi-Sulphate of Potash"	34.68	....	....
Average cost per pound of Potash			5.8	....

MURIATE OF POTASH.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Potash.	Cost of Potash per pound.	Cost of 2,000 pounds of Muriate.
			cts.	
1135	Mapes' F. and P. Guano Co., New York City	52.47	3.91	*$41 00
1142	Lister Brothers, Newark	52.10	4.08	42 50
1154	George B. Forrester, New York City	52.40	4.06	42 50
1161	H. J. Baker & Bro., New York City	54.86	4.20	46 00
1169	C. Meyer, Jr., Maspeth, L. I.	51.70	4.10	42 50
1183	Bowker Fertilizer Co., New York City	51.58	3.88	40 00
1188	Williams, Clark & Co., New York City	51.78	3.86	40 00
1199	Kimball & Prince, Vineland	51.02	3.95	40 27
1207	E. Frank Coe, New York City	55.24	....	....
1217	M. L. Shoemaker & Co., Philadelphia	54.26	3.69	40 00
1224	Moro Phillips, Camden	52.64	....	....
1230	U. S. Chemical Co., Camden	56.06	3.57	40 00
1235	Sharpless & Carpenter, Philadelphia	52.68	4.27	45 00
1246	Baugh & Son, Philadelphia	50.76	4.43	45 00
1247	Alex. Kerr, Bros. & Co., Philadelphia	52.16	3.55	37 00
1249	Garrison & Minch, Bridgeton	52.18	4.40	46 00

Average cost of Potash per pound in Muriate............ 4 cents.

1872	Salzbergwerk, New Stassfurt, Germany	52.98	3.40	†36 00

* Delivered in car-load lots at the Moorestown depot. † Sold to the Rio Grand Sugar Company at $34 per ton, of eighty per cent. Muriate. Sample represents one hundred tons used upon this sorghum plantation during the spring of 1886.

THE GUARANTEED CHEMICAL COMPOSITION AND RELATIVE COMMERCIAL VALUES OF MERCHANTABLE FERTILIZERS.

An act to regulate the manufacture and sale of fertilizers.

[Laws of New Jersey for 1874, page 90.]

1. That every commercial fertilizer which shall be offered for sale in this state shall be accompanied by an analysis, stating the percentage therein of ammonia, or its equivalent of nitrogen; of potash, in any form or combination, soluble in distilled water; and of phosphoric acid in any form or combination; the portion of phosphoric acid soluble in distilled water; that portion soluble in a neutral solution of citrate of ammonia at a temperature not exceeding one hundred degrees Fahrenheit; and that portion of phosphoric acid not soluble in either of the above-named fluids, shall each be determined separately; and the material from which the phosphoric acid is obtained shall also be stated; a legible statement of such analysis shall accompany all packages or lots of over one hundred pounds sold, offered or exposed for sale.

5. That any person selling, offering or exposing for sale any commercial fertilizer without the analysis required by the first section of this act, or the act to which this act is a supplement, or with an analysis stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense; *provided further*, that the provisions of this section, or the act to which this act is a supplement, shall not apply to any manure sold at a price not exceeding one-half a cent per pound, nor to any imported guanos.

Farmers believe that it is the duty of this Station:

1. To sample, officially, every brand of fertilizer which is offered for sale in this State.

2. To publish the official analysis of said brands in comparison with their manufacturers' guarantees.

3. To state the retail cash value of the plant-food present in each brand.

4. To publish the results in a manner which admits of a rapid and fair comparison of the commercial values of the different brands.

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Any other inf
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packed for transportation in a wooden box, properly closed. Th
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THE NEW JERSEY AGRICULTURAL EXPERIMENT STATION,
GEO. H. COOK, *Director*
New Brunswick,

LABORATORY METHODS.

Early in the spring, every fertilizer manufacturer whose add known at this Station was requested to give the names and guar analyses of the brands which he intended to place upon the Jersey market during the season of 1886. In nine cases out c this information was furnished promptly, but in several ins the circular was not answered, and in one case the answer was tive refusal.

The names of the brands and their guaranteed analyses, a nished by their manufacturers, were entered in an appropriate a copy of one page of which is here published for illustratic manufacturer's name being omitted and letters being substitut the names of his brands:

Manufacturer.	Brand.	GUARANTEED ANALYSIS.							SAMPLED BY.				
		Ammonia.	Soluble Phos. Acid.	Reverted Phos. Acid.	Insoluble Phos. Acid.	Available Phos. Acid.	Total Phos. Acid.	Potash.	I. W. Nicholson.	H. I. Budd.	J. M. White.	T. F. Baker.	J. H. Denise.
....	A.........	4½-5	......	......	......	......	8-10	6-8	1296	1334	1323	1261	131
....	B.........	4½-5	......	......	......	......	10-12	6-7	....	**1335**	1325	1489	14
....	C.........	5½-6½	......	......	......	......	6-8	8-10	....	....	**1322**	....	.....
....	D.........	2-3	......	......	......	......	7-9	11-12	....	....	....	....	**143**
....	E.........	6-8	......	......	......	......	7-9	6-8	....	....	....	**1263**	14
....	F.........	3-4	......	......	......	......	12-16	2½-3½	1295	1333	1324	1262	13
....	G.........	4-5	......	......	......	......	10-12	4-5	**1297**	....	1391	....	......
....	H........	2½-3	......	......	......	......	11-13	2½-3	....	....	....	....	......
....	I.........	1½-2	......	......	......	......	12-14	1½-2	....	....	**1466**	....	......

the guaranteed analysis of the brand which it represented, and directly beneath the name of the inspector by whom this sample was taken.

From the above copy, it will be evident that brands lettered A and F were widely distributed, every inspector having found them for sale in his district. It will also be noticed that one number only, opposite each brand, has been printed in black-faced type. This indicates the particular sample of that brand which was selected for analysis. One such entry, at least, is found under each inspector's name, showing that the analyses which represent this manufacturer were made upon samples drawn from six widely-different localities.

This detailed description of the sampling and of the laboratory methods is here published for the benefit of thoughtless or badly-informed traveling salesmen, who sometimes insinuate that their business rivals place specially-prepared lots of fertilizers where they will be found by unsuspecting inspectors, and that, consequently, these rivals have succeeded in securing favorable reports upon samples which do not represent their average product. No importance is attached to such charges by those who are familiar with the details of this work.

2.

THE STATION'S ANALYSES OF BRANDS, COMPARED WITH THEIR MANUFACTURERS' GUARANTEES.

A State law provides definitely as to the manner in which several of the necessary chemical determinations shall be made. This law is rigorously obeyed in the Station's laboratory, but in cases where latitude is allowed the analysts, the methods recognized by the Association of American Chemists have been adopted with slight modifications. The laboratory rules demand that all determinations shall be made in duplicate, that duplicates shall not be made either upon the same solutions or upon the same day, and that whenever it is possible duplicates shall be made by two radically different methods.

In all cases the Station's analyses of brands are compared with their manufacturers' guarantees, prominence being given to the comparison by the use of black-faced type. Out of one hundred and forty-six samples examined this season, eighty-two contain more nitrogen, more available phosphoric acid, and more potash, than their manufacturers claim, while six fall below their guarantees in all respects. Fifty-eight per cent., therefore, of the brands used in New Jersey this season were better than their manufacturers promised, while four per cent. were in all respects below grade. These percentage results are identical with those of last year.

Of the remaining samples twenty-four contain less nitrogen, thirty-one contain less available phosphoric acid, and thirty-four contain less soluble potash, than their guarantees require. In many cases the deficiency is hardly appreciable when expressed in dollars and cents; in several cases it is more than counter-balanced by an excessive amount of some other valuable ingredient, indicating irregularity in making the mixture; and in no case do the indications point to deliberate fraud. While, therefore, the condition of the fertilizer trade in New Jersey is still open to marked improvements, it is evident that it now compares favorably with that of any other State.

3.

THE RETAIL CASH VALUE OF THE PLANT-FOOD FOUND IN EACH BRAND.

In order that the results of the chemical analyses may be turned to practical use, it has been customary for many years for Stations to publish a commercial valuation for each brand of fertilizer. This necessitates the adoption of a price list, giving the cost per pound of nitrogen, phosphoric acid and potash, in the various forms in which these elements appear upon the market.

SCHEDULE OF TRADE VALUES ADOPTED BY EXPERIMENT STATIONS FOR THE SEASON OF 1886.

At a meeting of Stations' Directors and Chemists, the following schedule was arranged for use in Connecticut, Massachusetts and New Jersey during the season of 1886.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	Cents per pound.	
	1885.	1886.
Nitrogen in Ammonia Salts	18	18½
" " Nitrates	18	18½
" " Dried and fine ground fish	18	17
Organic Nitrogen in guano, dried and fine ground blood and meat	18	17
" " " cotton seed and linseed meal and in castor pomace	18	17
" " " fine ground bone	18	17
" " " fine medium bone	16	15
" " " medium bone	14	13
" " " coarse medium bone	12	11
" " " coarse bone, horn shavings, hair and fish scrap	10	9
Phosphoric Acid, soluble in water	9	8
" " " " ammonium citrate*	8	8
" " insoluble in dry, fine ground fish and in fine bone	6	7
" " " " fine medium bone	5½	6
" " " " medium bone	5	5
" " " " coarse medium bone	4½	4
" " " " coarse bone	4	3
" " " " fine ground rock phosphate,	2	2
Potash as High Grade Sulphate	7¼	5½
" " Kainite	4¼	4¼
" " Muriate	4¼	4¼

Station valuations are intended to represent the retail cash cost of the nitrogen, phosphoric acid and potash, *before the crude materials containing these elements have been mixed with each other to form a complete fertilizer.*

These valuations, therefore, are not intended to cover the expenses of mixing, bagging and transporting fertilizers from the factory to the farms. Such expenses depend upon the location of the works, the knowledge and facilities of the manufacturer, and the skill of his employes—conditions which cannot easily be estimated in dollars and cents. If, for example, the Station estimates the value of a given brand at $40 per ton, it means that for $40 a farmer can buy enough *unmixed material* to furnish the amount of nitrogen, phosphoric acid and potash shown by analysis to be present in that brand. If the farmer wants to learn how much this brand should cost him when ready for the drill, he must add to the $40 the expenses of mixing the crude materials with each other, packing the mixture into bags and freighting it to his farm.

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* The solubility of phosphates, in ammonium citrate solutions, is seriously affected by heat. An act of the Legislature (see Laws of New Jersey, 1874, page 90,) provides that in this determination the temperature used shall not exceed 100° Fah.; in Connecticut and Massachusetts 150° Fah. has been adopted. The higher the temperature the larger will be the percentage of phosphoric acid dissolved by ammonium citrate solutions, and the larger the amount of this so-called "reverted" phosphoric acid in a ton of superphosphate the lower will be the price per pound of said acid. Consequently the Stations' valuation of phosphoric acid, soluble in ammonium citrate, has been fixed at *seven and one-half cents per pound* for Connecticut and Massachusetts, and at *eight cents per pound* for New Jersey.

Before this schedule was used by this Station its accuracy was subjected to the following severe test: one hundred and twenty samples of crude material, including all of the best sources of plant-food, were collected, analyzed and the retail cost of their nitrogen, phosphoric acid and potash accurately determined. The schedule secured in the above manner, of *manufacturers' average retail cash prices* for plant-food in fertilizer supplies, has already been considered in detail in this report. In comparison with the Station's schedule it appears as follows:

COMPARISON BETWEEN STATION'S SCHEDULE AND MANUFACTURERS' AVERAGE RETAIL PRICES OF PLANT-FOOD IN FERTILIZER SUPPLIES.

	MANUFACTURERS' AVERAGE.		Station's schedule of prices for 1886.
	Retail prices for 1885.	Retail prices for 1886.	
	cts.	cts.	cts.
Cost per pound of Nitrogen from Nitrate of Soda	16.1	18.2	18.5
" " " " " " Sulphate of Ammonia	16.7	18.1	18.5
" " " " " " Dried Blood	15.5	20.0	17.0
" " " " " " Dried Fish	14.8	16.6	17.0
" " " " " " Ammonite	16.1	16.6	17.0
" " " " Soluble Phosphoric Acid from Bone Black	7.8	7.8	8.0
" " " " " " " " S. C. Rock	8.6	7.4	8.0
" " " " Reverted " " " Bone Black	6.9	7.8	8.0
" " " " " " " " S. C. Rock	7.6	7.4	8.0
" " " " Insoluble " " " Bone Black	1.7	1.9	2.0
" " " " " " " " S. C. Rock	1.9	1.9	2.0
" " " " Potash from High Grade Sulphate	6.7	5.8	5.5
" " " " " " Double Sulphate of Potash and Magnesia	6.8	6.5	5.5
" " " " " " Kainite	4.5	4.2	4.25
" " " " " " Muriate	4.1	4.0	4.25

very closely the average rates charged by manufacturers; in two cases, however, noticeable differences occur. The Station's valuations for nitrogen in *dried blood*, and for the potash in the *double sulphate of potash and magnesia* are comparatively low. As regards dried blood this result was unexpected, as nothing in the wholesale market necessitated the advance. No retail trade exists in the double sulphate of potash; its retail quotations, therefore, indicate what dealers have charged, not what consumers have paid for it; its retail prices average more than fifty per cent. higher than its wholesale quotations.

This schedule has been used in calculating the retail cash value of—

150 samples of Complete Fertilizers.
19 samples of Ground Bone.
5 samples of Dissolved Bone.
8 samples of Bone and Potash.

The analysis and valuation of each sample may be found upon subsequent pages.

PUBLICATION.

When results of importance have been secured, they are published in bulletin form, and six thousand copies are circulated among the farmers and dealers of this State. Copies are also mailed to all of the State newspapers, and to all manufacturers whose brands have been inspected; but the custom observed in several States, of submitting to a manufacturer, for his approval or criticism, the official analyses of his brands previous to their publication, has not been adopted by this Station.

These bulletins contain the analyses in detail, the estimated value of the plant-food in each brand, and its retail cash price per ton at its manufacturer's depot. These prices have been easily obtained every season until the last, when in spite of unusual efforts such prices could not be secured for more than one-half of the brands analyzed.

List of

Mapes' F. and
Bowker Fertili
Stearns & Co....
Bradley Fertili
William T. All
Crocker Fertili
J. J. Allen's So
Granger Fertili
A. Mitchell......
American Oil a
Equitable Fert
Groves & Daget
Garrison & Min
John Reed.......
Quaker City M
Arthur L. Sard
H. J. Baker & B
H. Doughten....
Clark's Cove G
Theo. Glaser.....
Ebeling Bros....
E. Frank Coe....
Powell, Morse &
Lord & Polk.....
T. Clancy..........
Pacific Guano C
Newton & Ludl
J. E. Tygert & C
John Taylor & (
Dambmann Bro
Read & Co.........
Williams, Clark
Wenderoth & So
Sharpless & Car
I. P. Thomas.....
N. J. Chemical (
U. S. Chemical (
H. B. Griffin......
Moro Phillips....
Preston Fertilize
M. L. Shoemake
J. P. White's Sor
Lister Bros........
Peninsular Ferti
J. C. Gaskill........
Depue, Son & Co
Excelsior Fertili
George B. Forres
John I. Smith.....
C. Meyer, Jr........
Walton, Whann
National Fertiliz

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
1263	Mapes' Light Soil	Mapes' F. and P. Guano Co., 158 Front street, New York City.	T. F. Baker, Bridgeton.
1297	Manure for General Use	" " " " " " " " "	I. W. Nicholson, Camden.
1317	" " Potatoes	" " " " " " " " "	J. H. Denise, Freehold.
1322	" " Cauliflower and Cabbage	" " " " " " " " "	J. M. White, New Brunswick.
1335	" " Corn	" " " " " " " " "	H. I. Budd, Mount Holly.
1363	Complete Manure, "A" Brand	" " " " " " " " "	Franklin Dye, Trenton.
1431	Manure for Fruit and Vine	" " " " " " " " "	J. A. Denise, Freehold.
1444	Nitrogenized Superphosphate	" " " " " " " " "	Franklin Dye, Trenton.
1466	Ammoniated Dissolved Bone with Potash	" " " " " " " " "	J. M. White, New Brunswick.
1266	Hill and Drill	Bowker Fertilizer Co., 27 Beaver street, New York City.	T. F. Baker, Bridgeton.
1346	Fish and Potash	" " " " " " " " "	H. I. Budd, Mount Holly.
1397	Dissolved Bone	" " " " " " " " "	J. H. Denise, Freehold.
1410	Stockbridge Potato Manure	" " " " " " " " "	I. W. Nicholson, Camden.
1438	Ammoniated Bone Phosphate	" " " " " " " " "	J. H. Denise, Freehold.
1448	Ammoniated Superphosphate	" " " " " " " " "	J. M. White, New Brunswick.
1567	Stockbridge Manure for Corn	" " " " " " " " "	J. J. Mitchell, Whippany.

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.			
												Found.	Guaranteed.					
1263	Mapes' Light Soil	0.76	2.56	1.97	5.29	4.94	4.03	3.90	2.44	10.37	7.00	7.93	....	6.56	6.00	6.96	38.71	48.00
1297	" Manure for General Use	0.84	1.42	1.69	3.45	3.30	6.30	5.43	1.67	13.40	10.00	11.73	....	4.38	4.00	3.05	35.79	41.00
1317	" " " Potatoes	0.78	1.71	1.39	3.88	3.71	5.15	4.66	2.08	11.89	8.00	9.81	....	6.77	6.00	0.62	38.13	46.00
1322	" " " Caulifl'er & Cabbage	0.51	2.24	2.18	4.93	4.53	3.92	4.15	1.51	9.58	6.00	8.07	....	8.21	8.00	7.97	38.38	43.00
1335	" " " Corn	0.55	1.30	2.40	4.25	3.71	7.20	4.64	1.32	13.16	10.00	11.84	....	6.22	6.00	5.53	40.03	44.00
1363	" Complete Manure, "A" Brand	0.53	0.56	1.95	3.04	2.47	7.04	4.98	2.02	14.04	12.00	12.02	10.00	3.04	2.50	4.21	33.68	38.00
1431	" Manure for Fruit and Vine	0.45	0.69	1.47	2.61	1.05	4.93	3.22	1.00	9.15	7.00	8.15	....	10.40	11.00	0.61	34.09	40.00
1444	" Nitrogenized Superphosphate	0.43	0.15	2.21	2.79	2.06	8.08	4.39	2.76	15.23	11.00	12.47	9.00	2.91	2.50	2.67	33.75	35.00
1446	" Am. Dissolved Bone with Potash	......	0.21	1.01	1.22	1.23	8.70	3.42	0.90	13.02	12.00	12.12	10.00	2.45	1.50	5.21	26.22	30.00
1266	Bowker's Hill and Drill	......	0.11	2.21	2.32	2.50	7.02	1.26	3.32	11.60	11.00	8.28	....	2.00	1.08	2.18	24.86	....
1346	" Fish and Potash	......	0.11	2.26	2.37	2.25	3.78	2.37	1.47	7.62	8.00	6.15	....	4.48	4.00	10.42	22.62	....
1397	" Dissolved Bone	......	0.10	1.54	1.64	1.65	10.16	0.83	2.09	13.08	10.00	10.99	....	1.17	1.10	0.46	25.59	....
1410	" Stockbridge Potato Manure	......	1.90	1.48	3.38	3.25	9.33	1.70	0.81	11.87	....	11.03	8.00	7.94	7.00	8.82	36.96	....
1433	" Ammoniated Bone Phosphate	......	0.18	0.90	1.08	1.65	8.27	0.57	2.85	11.69	7.00	8.84	....	3.08	2.08	1.23	22.55	....

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
												Available.							
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.				
1272	Stearns & Co.'s Eagle Brand..............	......	0.15	1.42	1.57	1.64	1.77	1.34	0.55	3.64	5.00	3.11	3.26	2.19	....	5.03	12.55	....	127
1588	" " Ammoniated Bone.....	......	0.12	2.52	2.64	2.25	5.57	2.70	2.61	10.88	9.00	8.27	....	4.03	2.00	6.14	27.24	....	158
1273	Bradley's Complete, for Fruit Trees ...	0.45	0.10	2.47	3.02	2.05	4.21	2.06	1.91	8.18	10.00	6.27	....	5.98	5.40	3.20	27.14	42.50	127
1274	" Superphosphate of Lime.....	......	0.47	2.63	3.10	2.46	8.25	0.90	2.91	12.06	10.00	9.15	8.00	2.47	2.00	2.55	29.18	38.00	127
1587	" Potato & Vegetable Manure.	......	0.50	3.25	3.75	3.69	10.83	......	trace.	10.83	9.00	10.83	8.00	6.65	6.00	6.26	35.88	42.50	158
1353	Wm. T. Allen's Complete Phosphate...	......	0.19	1.57	1.76	2.46	8.06	1.61	1.98	11.65	12.00	9.67	10.00	1.64	2.00	4.70	24.10	....	135
1354	" " Special Fertilizer	......	0.14	1.59	1.73	1.64	4.36	1.30	4.77	10.43	....	5.66	7.00	1.76	2.00	5.25	19.35	....	135
1355	" " Potato & Truck Man're	......	1.23	2.28	3.51	3.25	6.72	0.40	1.20	8.32	10.00	7.12	7.00	7.36	7.00	8.81	30.67	42.00	135
1379	Crocker's Queen City Phosphate........	......	0.09	1.92	2.01	1.64	7.01	0.68	2.13	9.82	9.00	7.69	8.00	1.69	1.00	1.48	21.89	....	137
1523	" Buffalo Am. Bone Superph..	... ..	0.07	3.68	3.75	2.87	8.16	0.99	1.90	11.05	9.00	9.15	8.00	1.78	1.00	1.61	32.29	....	152
1543	" Vegetable Bone Superphos..	......	0.11	5.04	5.15	4.92	4.61	1.65	0.42	6.68	7.00	6.26	6.00	5.12	6.00	4.81	32.17	....	154
1546	" Potato, Hop & Tobacco Fert.	......	0.08	2.35	2.43	2.05	8.39	1.65	1.53	11.57	9.00	10.04	8.00	3.81	3.00	3.76	28.51	....	154
1400	J. J. Allen's Sons' Ten Per Cent. Guano.	......	6.54	2.34	8.88	8.20	3.68	1.00	3.37	8.05	6.00	4.68	....	1.95	2.50	2.54	43.33	....	140
1510	" " Nitro-Phosphate	......	0.88	1.14	2.02	1.23	4.84	1.64	7.34	13.82	....	6.48	9.00	2.25	2.50	2.45	23.81	....	151

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
1409	Granger Fertilizer	Granger Fertilizer Co., Philadelphia, Pa.	I. W. Nicholson, Camden.
1440	Complete Manure	A. Mitchell, Tremley Point, Staten Island, N. Y.	J. H. Denise, Freehold.
1497	Bay Side Fertilizer	American Oil and Fertilizer Co., Greenwich, N. J.	T. F. Baker, Bridgeton.
1499	Potato Compound	Equitable Fertilizer Co., Baltimore, Md.	" " "
1500	Special Esmeralda Guano	" " " "	" " "
1502	Prime " "	" " " "	" " "
1250	Rose Bone Fertilizer	" " " "	H. I. Budd, Mt. Holly.
1251	Selected Esmeralda	" " " "	" " "
1493	Raw Bone Superphosphate, stock of 1885	Groves & Dagett, Wilmington, Del.	T. F. Baker, Bridgeton.
1517	Bone, Fish and Potash	Garrison & Minch, Bridgeton, N. J.	" " "
1269	Pride of Cumberland	" " " "	" " "
1561	Delta	John Reed, 33 Broadway, N. Y.	E. N. Millen, Deckertown, N. J.
1304	Lobos Guano	....	I. W. Nicholson, Camden.
1347	Quaker City Poudrette	Quaker City Manufacturing Co., Philadelphia, Pa.	H. I. Budd, Mt. Holly.
1408	No. 1 Peruvian Guano	....	I. W. Nicholson, Camden.
1479	Phospho Peruvian Guano	Arthur L. Sardy, 10 Burling Slip, N. Y.	I. M. White, New Brunswick.

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
1358	Potato Manure	H. J. Baker & Bro., New York.	Franklin Dye, Trenton.
1370	Oat Manure	" " " "	J. H. Denise, Freehold.
1381	Fruit Tree Manure	" " " "	" " "
1404	Onion Manure	" " " "	" " "
1405	Strawberry Manure	" " " "	" " "
1472	A. A. Ammoniated Superphosphate	" " " "	J. M. White, New Brunswick.
1478	Pelican Bone Fertilizer	" " " "	" " " "
1507	Corn Manure	" " " "	T. F. Baker, Bridgeton.
1255	Ammoniated Superphosphate	H. Doughten, Moorestown, N. J.	H. I. Budd, Mt. Holly.
1257	Potato Manure	" " " "	" " "
1298	Peach and Fruit, Special	Clark's Cove Guano Company, New Bedford, Mass.	I. W. Nicholson, Camden.
1299	Great Planet Formula "B"	" " " " " "	" " "
1301	Unicorn	" " " " " "	" " "
1371	Great Planet Formula "A"	" " " " " "	J. H. Denise, Freehold.
1506	King Philip	" " " " " "	T. F. Baker, Bridgeton.
1526	Bay State	" " " " " "	J. J. Mitchell, Whippany.

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.			
												Found.	Guaranteed.					
1858	Baker's Potato Manure	......	3.16	0.82	3.98	3.28	5.41	0.86	trace.	6.27	6.25	6.27	5.75	10.07	10.00	8.17	34.53	45.00
1870	" Oat Manure	......	3.55	1.00	4.55	4.10	5.43	0.61	trace.	6.04	....	6.04	5.00	8.81	9.00	9.94	33.70	45.00
1881	" Fruit Tree Manure	......	1.42	0.51	1.93	1.64	5.64	0.72	0.26	6.62	....	6.36	6.00	10.37	11.00	2.82	27.94	43.00
1404	" Onion "	......	3.24	1.04	4.28	4.92	7.18	1.04	0.29	8.51	5.50	8.22	4.50	8.53	9.00	6.24	36.15	45.00
1405	" Strawberry "	......	1.74	1.03	2.77	2.66	5.43	1.08	0.15	6.66	7.00	6.51	6.00	8.21	8.00	1.92	28.83	42.50
1472	" A. A. Ammoniated Superphos	......	2.49	0.91	3.40	2.46	11.29	0.39	0.21	11.89	13.00	11.68	10.00	2.35	2.00	2.96	33.11	37.50
1478	" Pelican Bone Fertilizer	......	0.52	1.12	1.64	1.85	9.87	0.49	0.26	10.62	10.00	10.36	9.00	2.29	2.25	5.45	24.41	32.50
1507	" Corn Manure	......	3.57	1.16	4.73	4.10	5.99	0.16	0.29	6.44	7.25	6.15	6.25	6.84	7.00	7.55	32.96	45.00
1255	Doughten's Ammoniated Superphos	......	0.30	2.67	2.97	2.05	7.85	1.04	1.41	10.30	....	8.89	9.00	0.81	....	2.41	25.95	31.00
1257	" Potato Manure	......	1.03	2.11	3.14	3.28	7.22	0.48	1.38	9.08	8.00	7.70	7.00	6.58	6.00	7.62	29.72	40.00
1298	Clark's Cove Peach and Fruit, Special	0.82	0.09	0.76	1.17	0.61	5.37	1.07	1.70	8.14	7.00	6.44	5.50	6.81	6.00	9.85	21.20	30.00
1299	" Great Planet Formula "B"	2.06	2.03	1.24	5.33	4.94	5.40	0.76	0.94	7.10	6.00	6.16	5.00	7.29	7.00	2.78	36.85	46.00
1301	" Unicorn	......	0.23	2.17	2.40	1.85	6.18	2.85	2.81	11.84	10.00	9.03	8.50	2.63	2.25	1.42	26.79	33.00
1871	" Great Planet Formula "A"	......	2.56	2.27	4.83	3.28	7.22	0.41	0.84	8.47	8.25	7.63	7.25	9.12	9.50	[illegible]	27.70	44.00

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
1568	Union Co. Fertilizer	Theo. Glaser, Linden, N. J.	J. J. Mitchell, Whippany.
1570	Newark Poudrette	Ebeling Bros., Newark, N. J.	" " "
1812	High Grade Ammoniated Bone	E. Frank Coe, 16 Burling Slip, N. Y.	J. H. Denise, Freehold.
1815	Excelsior Red Brand	" " " " "	" " "
1818	High Grade Knickerbocker	" " " " "	J. M. White, New Brunswick.
1819	Ralston's Ammoniated Bone Superphosphate	" " " " "	" " " "
1820	Potato Manure	" " " " "	" " " "
1857	Alkaline Bone	" " " " "	Franklin Dye, Trenton.
1867	Peach Tree Fertilizer	" " " " "	J. H. Denise, Freehold.
1448	XXV. Phosphate	" " " " "	Franklin Dye, Trenton.
1558	Ammoniated Bone Superphosphate	" " " " "	J. J. Mitchell, Whippany.
1559	Excelsior	" " " " "	" " "
1841	Virginius	Powell, Morse & Co., Hoffman's Wharf, Va.	H. I. Budd, Mt. Holly.
1509	Ocean Guano	" " " " " "	T. F. Baker, Bridgeton.
1413	Truxillo Guano	Lord & Polk, Odessa, Del.	I. W. Nicholson, Camden.
1415	Bone Phosphate	T. Clancy, New Brunswick, N. J.	J. M. White, New Brunswick.

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.			
1568	Theo. Glaser, Union Co. Fertilizer..........	......	0 26	1.21	1.47	1.64	5.03	0.78	3.03	8.84	10.00	5.81	....	2.57	2.00	5.76	18.37	....
1570	Ebeling Bros.' Newark Poudrette...........	0.13	tra.	0.77	0.90	....	0.56	1.60	0.26	2.42	....	2.16	....	0.31	....	0.17	7.01	....
1812	Coe's High Grade Ammoniated Bone	......	0.30	1.85	2.18	2.05	7.68	1.40	2.90	11.98	10.00	9.08	9.00	1.87	1.00	0.87	25.53	....
1815	" Excelsior Red Brand..........................	......	0.98	2.70	3.68	3.28	8.06	1.31	1.05	10.42	....	9.37	10.00	4.41	4.86	0.57	33.11	....
1818	" High Grade Knickerbocker...........	......	0.52	1.70	2.22	1.85	8.58	1.02	3.32	12.92	10.00	9.60	9.00	1.28	1.00	0.85	26.34	....
1819	" Ralston's Am. Bone Superphos......	......	0.18	1.71	1.89	0.82	7.33	1.66	2.03	11.02	....	8.99	9.00	4.42	2.72	0.51	26.78	....
1820	" Potato Manure..................................	......	0.19	1.59	1.78	1.64	7.49	1.56	2.00	11.05	10.00	9.05	8.00	4.45	3.80	0.48	26.52	....
1357	" Alkaline Bone......................................	......	0.16	1.29	1.45	0.82	8.10	1.86	3.88	12.84	10.00	9.46	9.00	1.68	1.63	0.29	23.90	....
1367	" Peach Tree Fertilizer..........................	......	0.18	1.41	1.59	0.82	7.26	1.36	3.16	11.78	....	8.62	6.00	3.93	4.86	0.80	25.21	....
1443	" XXV. Phosphate..................................	......	0.17	1.24	1.41	0.82	7.35	2.42	3.46	13.23	9.00	9.77	7.00	1.26	0.81	1.36	23.64	....
1558	" Ammoniated Bone Superphos.......	......	0.09	1.71	1.80	1.64	7.66	0.13	3.90	11.69	....	7.79	8.00	1.41	1.00	0.41	22.37	....
1559	" Excelsior..	......	1.00	2.37	3.37	3.28	8.81	1.60	1.31	11.75	10.00	10.41	10.00	3.24	2.72	0.43	32.64	....
1341	Powell, Morse & Co., Virginius...............	tra.	0.93	2.91	3.84	3.28	0.58	7.17	4.41	12.19	9.00	7.75	7.00	1.68	1.00	3.08	29.83	....

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
1434	Soluble Pacific Guano	Pacific Guano Company, Boston, Mass.	J. H. Denise, Freehold.
1451	Cereal Fertilizer	Newton & Ludlam, 182 Front St., N. Y.	J. M. White, New Brunswick.
1268	Star Bone Phosphate	J. E. Tygert & Co., Philadelphia, Pa.	T. F. Baker, Bridgeton.
1332	Complete Fertilizer for Potatoes, Truck and Tobacco	John Taylor & Co., Trenton, N. J.	J. M. White, New Brunswick.
1342	" " " Wheat, Oats and Grass	" " " "	H. I. Budd, Mt. Holly.
1359	Ammoniated Dissolved Bone and Potash	" " " "	Franklin Dye, Trenton.
1360	Complete Fertilizer for Corn and Truck	" " " "	" " "
1385	Arlington B., for all Crops	Dambmann Bros. & Co., Baltimore, Md.	J. M. White, New Brunswick.
1388	Alpha Soluble Bone and Potash	" " " " "	" " " "
1439	Arlington Fertilizer for Truck	" " " " "	J. H. Denise, Freehold.
1524	Wheat, Corn and Oat Fertilizer	" " " " "	J. J. Mitchell, Whippany.
1394	Cook's Blood Guano	Read & Co., 88 Wall St., New York.	J. M. White, New Brunswick.
1428	Ammoniated Bone Superphosphate	Williams, Clark & Co., 101 Pearl St., New York.	H. I. Budd, Mt. Holly.
1441	Americus Potato Fertilizer	" " " " " "	J. H. Denise, Freehold.
1462	Royal Bone	" " " " " "	J. M. White, New Brunswick.
1425	Potato Fertilizer	Wenderoth & Son, Camden, N. J.	H. I. Budd, Mt. Holly.

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
1482	Soluble Tampico Guano	Sharpless & Carpenter, Philadelphia, Pa.	Franklin Dye, Trenton.
1516	No. 1 Bone Phosphate	" " " "	T. F. Baker, Bridgeton.
1495	Tip Top	I. P. Thomas, Philadelphia, Pa.	" " "
1496	Normal Superphosphate	" " " "	" " "
1278	Ammoniated Phosphate	Yarnell N. J. Chemical Co., Camden, N. J.	H. I. Budd, Mt. Holly.
1279	Yarnell's Fish	" " " " " "	" " "
1281	" High Grade Potato	" " " " " "	" " "
1282	" Bone	" " " " " "	" " "
1283	W. and C. Superphosphate	" " " " " "	" " "
1412	Acidulated Fish Guano	N. J. Chemical Co., Camden, N. J.	I. W. Nicholson, Camden.
1477	I. L. Lofland's Button Bone	" " " " "	J. M. White, New Brunswick.
1287	National Potato Fertilizer	U. S. Chemical Co., 8 South Front, Philadelphia.	H. I. Budd, Mt. Holly.
1288	" Tobacco "	" " " " " "	" " "
1291	" Lawn "	" " " " " "	" " "
1345	" Superphosphate	" " " " " "	" " "
1593	Griffin's Superphosphate	H. B. Griffin, 70 Cortlandt St., New York City.	Assistant Chemist of Station.

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.			
												Found.	Guaranteed.					
1482	Sharpless & Carpenter's Sol. Tamp. Guano.	......	0.17	2.00	2.17	2.46	6.12	2.08	4.79	12.99	....	8.20	8.00	3.15	....	3.41	26.11	......
1516	" " " No. 1 Bone Phos...	....	tra.	1.12	1.12	1.23	4.40	2.38	4.64	11.42	....	6.78	6.00	1.57	1.50	4.07	18.77	......
1495	I. P. Thomas' Tip Top..............................	0.45	tra.	2.00	2.45	2.05	7.49	2.26	8.13	12.88	13.00	9.75	10.00	2.36	2.50	2.39	27.96	36
1496	" " Normal Superphosphate....	0.24	tra.	1.00	1.24	0.82	4.45	3.35	3.55	11.35	9.00	7.80	7.00	2.73	1.50	4.54	21.22	25
1278	N. J. Chem. Co. Ammoniated Phosphate.	......	0.27	0.87	1.14	0.82	7.95	1.01	2.88	11.84	....	8.96	9.00	2.45	1.50	6.97	22.11	......
1279	" " " Yarnell's Fish..................	......	0.22	1.32	1.54	2.05	7.24	1.51	3.39	12.14	....	8.75	9.00	1.82	3.00	4.79	22.88	......
1281	" " " " High Grade Potato.	......	0.90	2.09	2.99	3.28	7.10	1.68	2.36	11.14	....	8.78	9.00	5.09	5.00	4.97	30.24	......
1282	" " " " Bone................	......	0.91	1.65	2.59	1.64	7.70	1.31	2.43	11.44	11.00	9.01	....	3.49	3.00	3.41	27.94	......
1283	" " " W. & C. Superphosphate...	......	0.65	1.32	1.97	2.05	6.81	1.25	4.89	12.98	13.00	8.09	10.00	2.11	1.00	2.78	24.56	35
1412	" " " Acidulated Fish Guano...	......	0.30	1.46	1.76	2.05	6.34	0.70	4.93	11.97	13.00	7.04	10.00	1.98	1.50	1.83	21.97	36
1477	" " " I. L. Lofland's But'n Bone	......	1.11	0.55	1.66	1.23	5.41	2.51	3.02	10.94	11.50	7.92	10.00	3.62	3.00	5.05	23.55	37
1287	U. S. Chem. Co.'s Nat'l Potato Fertilizer...	......	tra.	1.55	1.55	1.50	4.63	[illegible]	2.65	10.10	9.00	7.45	8.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
1293	Superphosphate	Moro Phillips, Philadelphia, Pa.	H. I. Budd, Mt. Holly.
1294	Phuine	" " " "	" " "
1401	Potato Fertilizer	Preston Fertilizer Co., Greenpoint, L. I.	J. H. Denise, Freehold.
1484	Ammoniated Bone Phosphate	" " " " "	Franklin Dye, Trenton.
1549	" " Superphosphate	" " " " "	J. J. Mitchell, Whippany.
1551	Corn Fertilizer	" " " " "	" " "
1313	Swift Sure Phosphate	M. L. Shoemaker & Co., Philadelphia, Pa.	J. H. Denise, Freehold.
1447	$28 Superphosphate	" " " " "	Franklin Dye, Trenton.
1572	Good Enough Superphosphate	" " " " "	H. I. Budd, Mt. Holly.
1578	Echo	" " " " "	" " "
1392	Potato Fertilizer	J. P. White's Sons, 41 Peck slip, New York City.	J. M. White, New Brunswick.
1311	" Manure	Lister Bros, Newark, N. J.	J. H. Denise, Freehold.
1452	Success	" " " "	J. M. White, New Brunswick.
1458	Ammoniated Dissolved Bone	" " " "	" " " "
1459	U. S. Superphosphate	" " " "	" " " "
1580	Corn Manure	" " " "	J. J. Mitchell, Whippany.
1582	Standard	" " " "	" " "

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.			
1298	Moro Phillips' Superphosphate...........	......	0.08	1.84	1.92	1.64	6.82	1.68	8.00	11.50	....	8.50	8.00	2.34	2.16	0.96	24.21	....
1294	" Phuine........................	......	0.20	2.06	2.26	1.64	4.88	0.98	3.68	9.54	....	5.86	7.00	2.90	2.00	0.98	22.21	....
1401	Preston's Potato Fertilizer....................	......	0.90	2.60	3.50	3.28	6.78	0.98	1.80	9.06	....	7.76	8.00	5.43	7.00	2.78	30.43	....
1484	" Am. Bone Phosphate...........	......	0.29	2.68	2.97	2.45	6.89	1.19	2.83	10.91	....	8.08	8.00	0.81	....	1.78	25.49	....
1549	" " Superphosphate...	......	0.21	2.46	2.67	2.05	6.83	0.79	2.57	10.19	....	7.62	8.00	1.20	1.00	8.34	23.89	27.00
1551	" Corn Fertilizer.....................	......	0.83	1.93	2.76	2.46	5.80	1.44	1.22	8.46	....	7.24	9.00	7.51	7.00	8.95	28.88	....
1818	Shoemaker's Swift Sure Superphos......	0.61	0.07	2.39	3.07	2.46	9.14	2.86	1.88	13.88	14.00	12.00	9.00	5.23	4.00	4.45	35.44	36.00
1447	" $23 Superphosphate.........	tra.	tra.	1.45	1.45	0.82	7.39	1.14	1.98	10.51	8.00	8.53	6.00	2.20	1.00	4.45	21.63	23.00
1572	" Good Enough Superphos.	0.26	tra.	1.31	1.57	1.23	9.88	1.50	3.63	14.96	12.00	11.33	8.00	2.22	1.62	2.79	27.60	32.00
1578	" Echo Superphosphate....	......	tra.	1.12	1.12	0.82	7.04	1.25	2.89	11.18	9.00	8.29	7.00	2.05	1.00	4.56	20.54	25.00
1892	J. P. White's Sons' Potato Fertilizer....	......	0.49	2.54	3.03	2.46	8.18	1.23	2.13	11.54	14.00	9.41	9.00	4.21	4.32	3.78	30.37	40.00
1811	Lister's Potato Manure......................	......	4.06	0.76	4.82	3.69	9.00	0.22	tra.	9.22	....	9.22	8.50	8.20	7.00	7.72	39.33	44.00
1452	" Success................................	......	0.78	1.02	1.80	0.82	12.21	0.22	0.42	12.85	....	12.43	10.00	2.07	2.00	0.89	28.64	27.00
1458	" Ammoniated Dissolved Bone..	......	0.60	1.79	2.39	1.64	8.22	2.27	1.44	11.93	10.00	10.49	8.00	1.64	1.50	2.16	27.34	32.00
1459	" U. S. Superphosphate.	......	0.48	1.16	1.59	1.31	6.14	2.05	1.09	9.28	7.00	8.19	6.00	2.57	2.00	5.96	21.46	....
1580	" Corn Manure																	

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
1260	Planet Fertilizer	Peninsular Fertilizing Co., Smyrna, Del.	H. I. Budd, Mt. Holly.
1339	Special Fish Manure	J. C. Gaskill, Birmingham, N. J.	" " " "
1421	High Grade	" " " "	" " " "
1436	Popular Phosphate	" " " "	J. H. Denise, Freehold.
1534	High Grade Bone Superphosphate	Depue, Son & Co., Belvidere, N. J	D. F. Pursel, New Village.
1535	Extra Bone Superphosphate	" " " " "	" " " "
1537	Bone, Animal Matter, Kainite, &c	" " " " "	" " " "
1569	Normal, No. 1	Excelsior Fertilizing Co., New York.	J. J. Mitchell, Whippany.
1591	Potato Manure	G. B. Forrester, Brooklyn, N. Y.	A. W. Duryee.
1364	Standard Grain and Grass Fertilizer	John I. Smith, Trenton, N. J.	Franklin Dye, Trenton.
1378	Potato and Truck Fertilizer	" " " "	" " "
1368	Acme Fertilizer	C. Meyer, Jr., Maspeth, L. I.	J. H. Denise, Freehold.
1376	Plow Brand	Walton, Whann & Co., Wilmington, Del.	" " "
1398	Chittenden's Universal Phosphate	National Fertilizer Co., Bridgeport, Conn.	" " "
1521	" Ammoniated Bone Superphosphate	" " " " "	J. J. Mitchell, Whippany.
1522	" Fertilizer for Potatoes, Vegetables, &c	" " " " "	" " "
1536	" Fish and Potash	" " " " "	J. H. Denise, Freehold.

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
												Available.							
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.				
1260	Peninsular Fert. Co., Planet Fertilizer......	......	0.04	1.44	1.48	1.23	7.23	1.53	2.86	11.62	8.00	8.76	7.00	2.18	2.00	3.91	22.63	....	1260
1339	Gaskill's Special Fish Manure..................	......	0.12	2.00	2.12	2.46	5.57	1.20	1.55	8.32	7.00	6.77	6.00	3.67	4.00	6.97	22.12	34.00	1339
1421	" High Grade................................	tra.	0.13	2.86	2.99	3.28	5.18	0.91	2.50	8.59	8.00	6.09	6.00	5.65	6.00	6.54	26.25	44.00	1421
1436	" Popular Phosphate	......	0.14	2.01	2.15	2.46	6.43	0.96	2.71	10.10	7.00	7.39	6.00	3.84	4.00	4.25	24.07	34.00	1436
1534	Depue's High Grade Bone Superphosphate	......	0.38	1.30	1.68	2.00	2.59	2.79	1.54	6.92	10.00	5.38	....	6.15	5.00	8.10	20.58	32.00	1534
1535	" Extra Bone Superphosphate.........	0.20	0.11	0.59	0.90	2.00	3.00	1.71	2.27	6.98	8.00	4.71	....	2.66	4.00	6.22	14.32	28.00	1535
1537	" Bone, Animal Matter, Kainite, &c.	tra.	0.15	0.27	0.42	2.00	1.00	0.98	0.77	2.75	5.00	1.98	....	5.46	4.00	11.75	9.75	20.00	1537
1569	Excelsior Fert. Co.'s Normal, No. 1............	......	0.10	2.40	2.50	2.00	7.22	1.21	0.26	8.69	....	8.43	7.50	3.41	3.00	7.80	25.08	....	1569
1591	Forrester's Potato Manure.........................	tra.	4.59	......	4.59	3.48	7.24	0.36	0.22	7.82	....	7.60	5.25	9.35	10.00	3.15	38.50	45.00	1591
1364	J. I. Smith's Standard Grain and Grass Fert.	......	0.13	2.90	3.03	2.05	4.36	4.01	0.99	9.36	10.00	8.37	....	3.51	3.00	8.57	27.31	....	1364
1373	" Potato and Truck Fertilizer....	......	0.85	2.32	3.17	2.46	5.34	2.43	0.74	8.51	9.00	7.77	....	8.54	7.00	10.51	31.17	....	1373
1368	C. Meyer, Jr., Acme Fertilizer.....................	......	3.17	1.45	4.62	3.69	7.39	1.29	0.40	9.08	9.00	8.68	8.00	10.32	9.00	5.25	40.38	43.00	1368
1376	Walton, Whann & Co.'s Plow Brand..........	......	0.09	2.38	2.47	2.25	5.82	2.23	4.47	12.52	11.00	8.05	9.00	2.10	2.25	2.39	25.77	33.00	1376
1398	Nat. Fert. Co.'s Univ. Phos., Chittenden's..	......	0.06	2.64	2.70	2.05	5.78	3.52	3.03	12.33	10.00	9.30	8.00	2.33	2.00	2.68	27.88	35.00	1398
1521	" Chittenden's Am. Bone Superphos....	......	tra.	2.54	2.54	1.64	6.87	2.14	2.73	11.74	9.00	9.01	7.00	1.87	2.00	4.27	26.28	30.00	1521
1522	" " Fert., Potatoes, Vegetables, &c..	......	0.97	3.36	4.33	3.28	4.32	2.10	3.40	9.82	8.00	6.42	6.00	9.14	6.00	8.29	35.09	40.00	1522
1586	" " Fish and Potash.......................	......	0.92	3.82	4.74	3.28	2.03	3.69	1.41	7.13	6.00	5.72	....	3.99	5.00	5.84	29.78	35.00	1586

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station
1256	Doughten's Fish Guano	H. Preston Fertilizer Co., Greenpoint, L. I.	H. I. Budd, Mt. Holly, N. J.	12
1350	Dried Ground Fish Guano	James E. Otis, Tuckerton, N. J.	" " " "	13
1582	Dried Ground Fish	J. J. Allen's Sons, Philadelphia.	" " " "	15
1600	Ringoes Formula	Charles D. Coe, dealer, Flemington, N. J.	J. W. Swallon, Copper Hill, N. J.	16
1601	Gaskill's High Grade Manure	Walton, Whann & Co., Wilmington, Del.	H. I. Budd, Mt. Holly, N. J.	16

Analyses and Valuations.

Station number.	BRAND.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds.	Station
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
1256	Doughten's Dried and Ground Fish Guano	......	......	4.06	**4.06**	**4.12**	2.46	2.19	2.82	**7.47**	**5.00**	**4.65**	....	**0.38**	....	2.45	**22.95**	....	12
1350	**James E. Otis' Fish Guano**	......	0.91	4.75	**5.66**	**4.12**	0.25	3.24	3.00	**6.49**	**7.00**	**3.48**	....	**3.20**	**2.00**	7.84	**29.62**	....	13
1582	**Allen's Ground Fish**	......	0.92	1.97	**2.89**	**2.06**	3.03	2.31	4.26	**9.60**	....	**5.34**	**8.00**	**2.74**	**2.50**	4.94	**26.67**	....	15
1600	**Coe's Ringoes Formula**	......	......	0.79	**0.79**	**2.10**	7.05	1.55	2.34	**10.94**	....	**8.60**	**7.80**	**0.79**	**2.30**	3.07	**18.52**	....	16
1601	**Gaskill's High Grade Manure**	......	0.16	2.94	**3.10**	**3.28**	5.07	1.07	2.47	**8.61**	**8.00**	**6.14**	**6.00**	**5.56**	**6.00**	6.80	**26.63**	....	16

GROUND BONE

Furnishing Nitrogen and Insoluble Phosphoric Acid.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
1271	Raw Bone	A. W. South, Philadelphia, Pa.	Theo. F. Baker, Bridgeton.
1308	Button Bone	L. Moritz, Philadelphia, Pa.	I. W. Nichelson, Camden.
1337	Bone Meal	Sharpless & Carpenter, Philadelphia, Pa.	H. I. Budd, Mt. Holly.
1349	Star Bone	J. E. Tygert, Philadelphia, Pa.	" " " "
1426	Swift Sure Bone Meal	M. L. Shoemaker & Co., Philadelphia, Pa.	" " " "
1427	" " Ground Bone	" " " " "	" " " "
1429	Fine Bone	Mapes' F. and P. Guano Co., New York.	J. H. Denise, Freehold.
1457	Crescent Bone	Lister Bros., Newark, N. J.	J. M. White, New Brunswick.
1470	Ground Bone	H. Preston & Son, Greenpoint, L. I.	" " " "
1492	Pure Ground Bone	Groves & Dagett, Wilmington, Del.	Theo. F. Baker, Bridgeton.
1494	" " "	I. P. Thomas, Philadelphia, Pa.	" " " "
1518	Button Bone	Emil Wahl, Philadelphia, Pa.	" " " "
1519	Fine Animal Bone	National Fertilizer Co., Bridgeport, Conn.	J. J. Mitchell, Whippany.
1527	Pure Bone Meal	Williams, Clark & Co., New York.	" " "
1533	Pure Ground Bone	Lister Bros., Newark, N. J.	" " "
1538	" " "	Depue, Son & Co., Belvidere, N. J.	D. F. Pursel, New Village.
1553	Pure Bone	Crocker Fertilizer Co., Buffalo, N. Y.	

GROUND BONE

Furnishing Nitrogen and Insoluble Phosphoric Acid.

Station number.	MANUFACTURER.	MECHANICAL ANALYSIS.					CHEMICAL ANALYSIS.		Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds.
		Finer than 1/50 inch.	Finer than 1/25 inch.	Finer than 1/12 inch.	Finer than 1/6 inch.	Coarser than 1/6 inch.	Nitrogen.	Phosphoric Acid.		
1271	A. W. South	20.0	33.0	31.6	14.8	0.6	4.09	20.65	34.57	....
1308	L. Moritz	14.4	37.2	30.0	18.4	....	3.36	23.67	36.68	....
1337	Sharpless & Carpenter	44.2	54.0	1.8	....	....	3.91	19.10	36.96	....
1349	J. E. Tygert	31.1	55.0	11.4	2.5	....	2.91	22.17	36.15	....
1426	M. L. Shoemaker & Co.	56.6	31.0	11.4	1.0	....	5.62	21.76	45.81	....
1427	" " "	28.0	41.4	19.3	11.3	....	6.36	19.07	41.06	....
1429	Mapes' F. and P. Guano Co.	39.4	22.0	19.4	19.2	....	1.64	30.06	39.98	....
1457	Lister Bros.	32.0	25.0	23.0	20.0	....	3.98	12.98	26.17	....
1470	H. Preston & Son	12.0	34.0	17.0	16.0	21.0	3.37	11.57	20.86	....
1492	Groves & Dagett	48.7	46.0	5.3	....	....	3.93	20.61	38.99	....
1494	I. P. Thomas	45.3	48.0	6.7	....	....	3.95	20.81	38.41	....
1518	Emil Wahl	40.5	25.5	20.0	14.0	....	4.12	24.08	41.19	....
1519	S. B. Chittenden	35.6	20.7	18.8	20.4	4.5	1.73	13.08	19.60	....
1527	Williams, Clark & Co.	51.0	25.0	18.0	6.0	....	4.16	19.40	36.92	....
1533	Lister Bros.	26.0	23.9	26.7	23.4	....	4.00	12.25	24.79	....
1536	Depue & Co.	5.4	15.3	21.3	33.0	25.0	3.68	16.64	28.48	....
1553	Crocker Fertilizer Co.	53.8	27.0	16.0	3.2	....	4.18	20.92	39.49	....
1579	Baugh & Sons	33.5	48.5	18.0	....	....	4.30	22.41	41.87	....
1597	Peter Cooper Glue Co.	58.7	17.1	8.0	16.2	....	1.76	28.26	40.86	....

DISSOLVED BONES AND NITROGENOUS SUPERPHOSPHATES

Furnishing Nitrogen and Available Phosphoric Acid.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station number.
1309	Fish Guano	Preston & Son, Greenpoint, L. I.	I. W. Nicholson, Camden, N. J.	1309
1446	Ammoniated Dissolved Bone	M. L. Shoemaker & Co., Philadelphia, Pa.	Franklin Dye, Trenton, N. J.	1446
1539	" Bone	Depue, Son & Co., Belvidere, N. J.	D. F. Pursel, New Village, N. J.	1539
1562	Universal Ammoniated Dissolved Bone	Williams, Clark & Co., New York.	J. J. Mitchell, Whippany, N. J.	1562
1578	$25 Phosphate	Baugh & Sons, Philadelphia, Pa.	H. I. Budd, Mt. Holly, N. J.	1578

Analyses and Valuations.

Station number.	BRAND.	Nitrogen.		Phosphoric Acid.							Estimated Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
		Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.				
									Found.	Guaranteed.			
1309	Preston's Fish Guano	3.98	3.50	2.69	2.25	2.68	7.62	5.00	4.94	5.00	23.04	....	1309
1446	Shoemaker's Ammoniated Dissolved Bone	1.55	0.82	4.26	3.87	6.37	14.50	....	8.13	8.00	22.10	....	
1539	Depue's Ammoniated Bone	2.43	3.00	1.54	4.44	5.89	11.87	14.00	5.98	....			
1562	Williams, Clark & Co., Universal Am. Dis. Bone	1.97	1.64	5.63	3.45	2.91	11.99	10.00	9.08				
1578	Baugh & Sons' $25 Phosphate	2.47	2.05	6.14	0.73	4.17	11.04	....					

SOLUBLE BONE AND POTASH

Furnishing Available Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
1343	Soluble Bone and Potash	New Jersey Chemical Co., Camden.	H. I. Budd, Mt. Holly, N. J.
1518	Bowker's Superphosphate with Potash	Bowker Fertilizer Co., New York.	Theo. F. Baker, Bridgeton, N. J.
1599	Alkaline Phosphate	Arthur L. Sardy, New York.	C. H. Broach, Blackwell's Mills, N. J.

Analyses and Valuations.

Station number.	BRAND.	Phosphoric Acid.							Potash.		Chlorine.	Estimated Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.
		Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.			
							Found.	Guaranteed.					
1343	N. J. Chemical Co.'s Soluble Bone and Potash	9.37	1.41	3.06	13.84	....	10.78	11.00	4.91	2.50	4.33	23.26	....
1518	Bowker's Superphosphate with Potash	9.10	1.70	1.08	11.88	....	10.80	11.00	1.56	1.10	3.20	19.28	19.00
1599	Sardy's Alkaline Phosphate	9.35	2.12	1.52	12.99	10.00	11.47	9.00	2.40	3.00	2.20	21.30	....

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were sampled by Mr. Theo. F. Baker, of Bridgeton, N. J. The selling prices ranged from 15 to 17 cents per bushel.

The analyses show that these samples contain much lower percentages of phosphoric acid and potash than any leached ashes hitherto brought under the Station's notice; the percentages of lime also fall considerably below normal amounts.

For the sake of comparison, the analyses have been tabulated, with maximum, minimum and average records published in Reports of the Connecticut, Massachusetts and New Jersey Stations.

Samples 1128, 1129 and 1130 are thereby shown to contain from one-fourth to one-eighth only of the quantities of potash and phosphoric acid usually found in leached ashes:

Station number.	MANUFACTURER.	PERCENTAGE OF			
		Water.	Lime.	Phosphoric Acid.	Potash.
	LEACHED ASHES.				
1128	James Tully, Philadelphia	34.30	23.36	0.29	0.37
1129	J. S. Young & Co., Baltimore	29.29	33.52	0.15	0.16
1130	James Tully, Philadelphia	28.01	23.36	0.28	0.37
	Average	30.53	26.75	0.24	0.30
	LEACHED WOOD ASHES.				
	Connecticut Station Reports—Maximum Potash	35.00	28.10	1.30	2.30
	Connecticut Station Reports—Minimum Potash	35.00	23.20	1.40	0.70
	Average	32.24	27.66	1.42	1.20
	LEACHED WOOD ASHES.				
	Massachusetts Station Reports—Maximum Potash	14.40	34.33	1.79	2.25
	Massachusetts Station Reports—Minimum Potash	24.53	26.53	1.39	0.79
	Average	16.32	34.23	1.36	1.49
	LEACHED WOOD ASHES.				
	New Jersey Station Reports—Maximum Potash	....	33.92	1.33	1.39
	New Jersey Station Reports—Minimum Potash	....	29.60	1.10	0.66
	Average	....	37.73	1.31	1.46

AGRICULTUR

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to the discussion of q
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III. To study the
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corroborated.

IV. To direct attention to the agricultural value of low-priced waste products from manufactories.

The wool-waste experiments, begun in 1884, have been continued, and the development of clover, under certain conditions, noted and reported.

V. To test, roughly, the effects of plant-food upon certain soils and crops, at the same time to give farmers an opportunity to familiarize themselves with the appearance and the effects of the materials which, when mixed, form complete manures.

Experiments upon peach trees, rye and clover, reported at the close of this chapter, are examples of this work.

FIELD EXPERIMENTS UPON THE COLLEGE FARM,

NEW BRUNSWICK, MIDDLESEX COUNTY.

This farm contains approximately ninety-five acres, of which ninety acres, at least, is arable land. Its principal product is milk, sold for direct consumption both at wholesale and retail; its annual sales also include the wheat from thirteen acres, the rye from three or four acres, and varying amounts of rye straw and timothy hay.

The herd of forty milch cows, and the teams of working horses and mules consume all of the corn, oats and fodder grown upon the place, and large supplies of brewers' grains, bran and mixed feed are also purchased every year for their support. For a farm of this size, therefore, the available yard manure is far above the average both in quantity and quality.

In accordance with the opinions recognized in this section of the State, barn-yard manure is always spread on the sod which is to be turned under for corn. Oats, following corn in rotation, are grown without additional fertilizers, but the oat stubble is heavily manured for wheat, and an acid phosphate is usually drilled with the seed; nitrate of soda has also been used occasionally as a top dressing in the spring, particularly after an unusually severe winter.

As this farm has been thoroughly and carefully tilled, its productiveness has steadily increased under the above treatment, and it now affords a good example of land in first-class condition for staple crops. When a farm has been managed in this way for a number of

	FERTILIZERS.		CORN. 1883.		OATS. 1884.		WHEAT. 1885.		HAY. 1886.
Number of Plot.	Kind.	Weight per Acre Used in 1883, 1884 and 1885.	Bushels of Shelled Corn per Acre.	Pounds of Stalks per Acre.	Bushels of Oats per Acre.	Pounds of Straw per Acre.	Bushels of Wheat per Acre.	Pounds of Straw per Acre.	Pounds of Hay per Acre.
1	Nothing........................	....	63.9	4,500	42.0	1,540	18.1	960	3,300
2	Nitrate of Soda...........	150 lbs.	62.5	4,000	49.6	2,210	18.3	1,100	3,300
3	Superphosphate...........	350 lbs.	62.5	4,200	44.7	1,560	18.2	1,110	3,800
4	Muriate of Potash.......	150 lbs.	65.3	4,600	47.3	1,580	13.4	800	4,400
5	Nitrate of Soda........... Superphosphate............	150 lbs. 350 lbs.	69.4	4,050	66.7	2,400	20.7	1,490	4,600
6	Nothing........................	....	64.5	3,700	60.7	1,880	10.8	550	3,500
7	Nitrate of Soda........... Muriate of Potash.......	150 lbs. 150 lbs.	73.6	4,300	71.3	2,610	14.6	920	4,520
8	Superphosphate........... Muriate of Potash.......	350 lbs. 150 lbs.	71.0	4,600	65.3	2,140	18.2	960	4,420
9	Nitrate of Soda........... Superphosphate........... Muriate of Potash.......	150 lbs. 350 lbs. 150 lbs.	73.6	4,600	71.5	2,525	23.0	1,240	4,540
10	Plaster.......................	400 lbs.	63.9	3,800	59.8	2,160	7.7	500	3,340
11	Fine Barn-yard Manure	20 2-horse loads.....	70.8	4,400	66.2	2,720	22.2	1,720	7,140

I.

In its Effects upon Corn, Oats, Wheat and Grass, How does a Complete Fertilizer Compare with Barn-yard Manure?

The complete fertilizer used in this trial was made by mixing nitrate of soda, bone black, superphosphate and muriate of potash in such proportions that the product analyzed nitrogen, 3.7 per cent.; soluble phosphoric acid, 8.60 per cent.; potash, 11.50 per cent. It, therefore, compares favorably with the so-called potato and corn manures offered for sale by the leading manufacturers.

As has been already stated, this fertilizer was used upon plot 9

Number of Plot	FERTILIZERS.	VALUE OF CROP.				Value of Four Crops.	Cost of Fertilise for Four Crop
	Kind.	1883. Corn.	1884. Oats.	1885. Wheat.	1886. Hay.		
1	Nothing	$48.65	$17.22	$18.69	$21.45	$107.01	....
2	Nitrate of Soda	46.38	21.51	19.22	21.45	108.56	$12.15
3	Superphosphate	46.98	18.09	19.16	24.70	108.93	11.01
4	Muriate of Potash	49.72	18.93	14.06	28.60	111.31	9.00
5	Nitrate of Soda Superphosphate	50.32	27.21	22.36	29.90	129.79	23.16
6	Nothing	46.58	23.85	11.10	22.75	104.28	....
7	Nitrate of Soda Muriate of Potash	53.38	29.22	15.44	29.38	127.42	21.15
8	Superphosphate Muriate of Potash	52.85	26.01	19.68	28.73	127.27	20.01
9	Nitrate of Soda Superphosphate Muriate of Potash	54.28	29.03	23.80	29.51	136.62	32.16
10	Plaster	46.55	24.42	8.18	21.71	100.86	4.50
11	Fine Barn-yard Manure	52.14	28.02	24.28	46.41	150.85	90.00

Plots 1 and 6 were cultivated without the addition of fertilizers. Their total product for the entire rotation averaged $105.70 per acre.

The increased crops from plots 5, 7 and 8 were worth enough to pay the cost of the fertilizer, but the balance remaining was then too small to warrant the use, in general farming, of either of these mixtures. For instance, the cash value of the total product from plot 8 was $127.27 per acre; as the unmanured land yielded $105.70 per acre, it leaves $21.57 with which to meet fertilizer bills amounting to $20. This is the most favorable return indicated by this experiment. With the exception of the three plots above mentioned, there are no cases in which the increased yields are valuable enough to pay the expenses incurred for the plant-food used. *No combination of commercial fertilizers, therefore, has been profitably employed in this rotation.*

Plot 11 offers a most striking example of the long investments were $150.85 per acre, or an advance of $45.15 over tha unmanured ground. This advance was secured by the worth of manure, consequently if the next year's crop of as valuable as the last year's crop of mixed hay, the manure will be recovered and the profits will exist solely in t the farmer has succeeded in utilizing *sixty tons* of stable acre in a manner which admits of returns equivalent to $1. Under these conditions, therefore, the transaction is busines when the farm itself produces this manure at a profit, th meat and milk production is made to pay, without esti value of waste products.

In the above experiment there are two conditions which exercised undue influence upon the results:

I. Inequalities in the soil.
II. The excessive amounts of fertilizers used.

I.

INEQUALITIES IN THE SOIL.

The assumption was that two unmanured plots woul fairly what the soil alone was able to produce. Upon cor the yields from these plots were practically identical, but of oats, plot 6 appeared to be much richer than plot 1, whil year's wheat crop indicated that plot 1 was richer than pl need of much more careful study regarding the uniformity mental fields was apparent, and a second rotation was, theref in 1886. This trial included eighteen plots, each one-twen acre in area, alternate plots only being fertilized with the quantities of plant-food used in the former experiment. E ized plot, therefore, lies between two unmanured spaces, an reliable comparisons as to the effects of plant-food can th drawn from their crops.

II.

THE EXCESSIVE AMOUNTS OF FERTILIZERS USED

It is an extremely difficult matter to determine the q plant-food which can be profitably employed. If a failu claim that the first hundredweight rarely pays for itself, that profits are generally found in the second. If, on the other hand, unusually large amounts are spread, they point to the increased crops and suggest that the same gains might have followed had the amount of the fertilizer been reduced one-half.

In the experiments reported above, the practice of successful farmers was followed to a certain extent; manure and fertilizers were freely used upon corn and wheat—the grass crops, however, were expected to thrive upon the surplus plant-food remaining in the soil from previous dressings. Contrary to this practice, the oats were fertilized as heavily as either of the other grain crops, and expenses were thereby increased by at least thirty-three per cent.

In the rotation begun last spring the corn was manured and fertilized as usual. Wheat will also be treated in a similar manner, but the oats will not be fertilized in any way. It is possible, therefore, that this reduction in expenses and a more correct comparison of the products from the fertilized and unfertilized plots may modify or change the present opinion that the staple crops of this farm do not respond profitably to the use of commercial manures.

Temperature and rainfall exert, of course, a very marked influence upon crop development, and must be duly weighed in comparing the results of the old and new rotation. The following observations are therefore recorded for future use:

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FIELD EXPERIMENTS WITH FERTILIZERS ON CORN.

BY THEODORE WEST, COLLEGE FARM, NEW BRUNSWICK, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.		
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Ears.	Bushels of Shelled Corn.	Pounds of Stalks.
1	Nitrate of Soda	160 lbs.	$4.32	4,900	61.3	5,120
	No Fertilizer			4,000	50.0	4,800
2	Superphosphate	300 lbs.	3.20	3,680	46.0	5,200
	No Fertilizer			3,900	48.8	4,600
3	Muriate of Potash	150 lbs.	3.00	4,040	50.5	5,600
	No Fertilizer			3,760	47.0	4,660
4	Nitrate of Soda, 160 Superphosphate, 300	460 lbs.	7.52	4,260	53.3	5,200
	No Fertilizer			3,680	46.0	5,000
5	Nitrate of Soda, 160 Muriate of Potash, 150	310 lbs.	7.32	4,420	55.3	6,000
	No Fertilizer			3,320	41.5	5,200
6	Superphosphate, 300 Muriate of Potash, 150	450 lbs.	6.20	3,300	41.3	5,600
	No Fertilizer			3,500	43.8	4,700
7	Nitrate of Soda, 160 Superphosphate, 300 Muriate of Potash, 150	610 lbs	10.52	4,160	52.0	6,000
	No Fertilizer			3,360	42.0	5,200
8	Plaster	400 lbs.	1.50	3,140	39.3	5,300
	No Fertilizer			3,080	38.5	5,400
9	No Fertilizer			3,080	38.5	5,460
	Fine Barn-yard Manure	20 tons.	30.00	5,460	68.3	6,400

This experiment begins a rotation which has been planned to show:

I. The variations in yields between unmanured plots;

II. The effects both of barn-yard manure and commercial fertilizers upon the growth of corn, oats, wheat and grass.

The above plots are located in the center of a field which was cropped, in 1882, with fodder corn, grown with a heavy dressing of barn-yard manure. Since that time, without the addition of plant-food of any kind, it has yielded heavy crops of rye, clover and mixed hay.

The season was unfavorable for corn, the rainfall in May being *five inches*, in comparison with two and seven-tenths inches, the average for this month for the years 1883, 1884, 1885. This caused late planting on many farms, and, in consequence, the crops fell considerably below the average.

I.

THE VARIATIONS IN YIELDS FROM UNMANURED PLOTS.

In comparing the yields from the unmanured plots, it is evident that marked differences in fertility must exist, for plot 9 produced twelve bushels of shelled corn per acre less than plot 1. This decline in fertility, however, appears to be regular and gradual, for, when neighboring plots are compared, their differences in yield are seen to be easily within the range of experimental errors.

It has been noticed, in a former experiment, that the two unfertilized plots hitherto employed agreed very closely in their yields of corn and clover hay, but differed from each other widely in their crops of oats and wheat, without apparent cause. It is hoped, therefore, that the above experiment, when carried through its rotation, will aid in disclosing a reason for such differences and thereby increase the confidence felt in this branch of field work.

II.

THE EFFECTS OF COMMERCIAL FERTILIZERS UPON INDIAN CORN.

Nitrogen has this year been the most efficient element in the development of grain, its most favorable returns resulting from its combination with potash.

exercised unfavorable effects upon the grain development. Alone it reduced the yield below that from its unfertilized plots, and in combination its yields were less than the other elements produced without its aid. The largest return, viz., thirty bushels of shelled corn per acre, was caused by the barn-yard manure.

Of all of the elements, potash influences stalk development most favorably, and, when used alone, its yields excel those from its combinations. In this work, phosphoric acid stands next to potash, and nitrogen ranks lowest.

FIELD EXPERIMENTS BY MR. A. P. ARNOLD,

VINELAND, CUMBERLAND COUNTY.

The soil of this farm is a very sandy loam easily tilled, responsive to fertilizers and especially suitable for the cultivation of sweet potatoes, berries and small fruits in general. Dairying is not followed to any extent, and relatively little live stock is kept, consequently the supply of yard manure is limited. Commercial fertilizers are recognized as necessities and are used as freely as good management will warrant.

Mr. Arnold and his neighbors have been busily engaged for many years in studying the fertilizer markets and testing their own farms with various mixtures. At present, potash salts and acid phosphates are regarded with more favor than the ordinary brands of complete fertilizers.

In 1882 this Station offered its assistance in carrying out field trials to determine:

I. The effect of barn-yard manure upon a rotation of crops compared with the effects of the leading elements of plant-food used separately and in combinations.

II. The financial results which follow the use of commercial fertilizers.

The field selected for this work was, at that time, in blackberries. It was prepared for corn in the usual manner, and eleven plots, each one-tenth of an acre in area, were staked off in a favorable location. The kinds and quantities of plant-food used in 1882 upon each plot can be learned from a following table. During the succeeding years

were made in the original plan. Plot 11, therefore, rec
eighty tons of stable manure per acre. In like manner, plo
six hundred pounds of muriate of potash, plot 3 *fourte*
pounds of bone-black superphosphate, plot 9 twenty-si
pounds of a high-grade potato fertilizer per acre, &c., in
one-quarter of the above weights having been used broadcas
The crop returns were as follows:

Number of Plot.	FERTILIZERS.		YIELD PER ACRE.					
	Kind.	Weight per Acre Used Annually in 1882, 1883, 1884 and 1885.	1882.		1883.		1884.	
			Corn.		Sweet Potatoes.		Clover and Millet.	Cl
			Bushels of Shelled Corn.	Pounds of Stalks.	No. of Bushels Good.	No. of Bushels Poor.	Pounds.	Pounds. First Cut.
1	Nothing		15.8	1,450	25.0	33.4	910	44
2	Nitrate of Soda	150 lbs.	22.7	1,540	25.8	30.2	2,010	45
3	Superphosphate	350 lbs.	15.0	1,560	29.4	37.4	1,060	68
4	Muriate of Potash	150 lbs.	13.7	1,500	72.8	21.8	1,020	81
5	Nitrate of Soda Superphosphate	150 350 lbs.	20.7	1,820	32.0	32.8	2,210	1,07
6	Nothing		11.7	1,480	30.6	30.6	970	46
7	Nitrate of Soda Muriate of Potash	150 150 lbs.	25.1	1,600	65.0	28.6	2,430	76
8	Superphosphate Muriate of Potash	350 150 lbs.	14 4	1,630	80 6	37.2	1,200	1,53
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 150 lbs.	23.1	1,680	92.8	43.2	3,280	1,68
10	Plaster	400 lbs.	13.8	1,380	16.4	34.4	1,070	39
11	Fine Barn-yard Manure	20 2 horse loads	24.5	1,800	108.0	35.4	3,580	3,16

I.

The Effects Upon Crop Development of the Leading Elements of Plant-Food, when Used Separately and in Combination, Compared with the Effects of Barn-yard Manure.

Nitrate of soda exercised most marked effects upon corn and millet; practically it was valueless upon potatoes and clover. The superphosphate influenced the growth of clover noticeably, a result probably due largely to its phosphoric acid, for its other leading ingredient, viz., land plaster, when used alone upon plot 9, in no case indicated favorable action. The superphosphate yielded no returns when used on corn, potatoes and millet. Potash was the controlling element upon potatoes and clover; it was also without effect upon the growth of corn and millet.

The above-mentioned effects of these elements, when used singly, are also marked in their combinations; in every case, save one, the largest crops were secured by using the complete manure. (See plot 9.) Without exception, the crops from this plot were surpassed by those from plot No. 11. The yields of corn, potatoes and millet from plot 11 indicate a nominal superiority only of barn-yard manure, but the returns on clover prove that with its aid this light soil can produce 5,520 pounds of hay per acre, in comparison with 2,420 pounds, the yield from the complete fertilizer; it shows, too (compare plots 11 and 6), that the stable manure increased the hay crop nearly ten-fold; this was done, however, at a very considerable outlay. The discussion of the financial returns will be aided by the following table:

Number of Plot.	FERTILIZERS.	VALUE OF CROP.				Value of Four Crops.
	Kind.	1882. Corn.	1883. Sweet Potatoes.	1884. Clover and Millet.	1885. Clover.	
1	Nothing	$16.14	$25.85	$9.10	$3.90	$54.9
2	Nitrate of Soda	21.28	25.61	20.10	3.96	70.9
3	Superphosphate	15.96	29.93	10.60	6.60	63.0
4	Muriate of Potash	14.84	56.41	10.20	7.44	88.8
5	Nitrate of Soda Superphosphate	20.86	30.60	22.10	9.06	82.6
6	Nothing	13.37	29.07	9.70	3.48	55.6
7	Nitrate of Soda Muriate of Potash	23.17	52.65	24.30	6.54	106.6
8	Superphosphate Muriate of Potash	15.79	65.77	12.00	12.90	106.4
9	Nitrate of Soda Superphosphate Muriate of Potash	22.05	75.76	32.80	14.52	145.1
10	Plaster	14.49	20.08	10.70	4.68	49.9
11	Fine Barn-yard Manure	23.45	85.45	35.80	33.12	177.8

II.

The Financial Results which Follow the Use of Comme Fertilizers.

The above calculations are based upon the market prices ruled at the time these crops were ready for sale. The total cash of the products from the unmanured plots (1 and 6) agree and average $55.30 per acre.

The increased crops due to nitrate of soda returned the a invested for this salt, but left no balance. Potash influenc profits in a very marked manner; the increased returns from were sufficient to leave a balance of $21.59 after fertilizer charg been met and due credit allowed for the product from the unm ground. *$21.59 is one hundred and eighty per cent. of $12.* *cost of 600 lbs. of muriate of potash.*

nitrogen and phosphoric acid, respectively, also gave profitable crops, the net gains being $23.16 in one case and $24.48 in the other. The combination of nitrogen, phosphoric acid and potash (plot 9) called for the largest investment but yielded the largest net profit, viz., $47.03, *or one hundred and ten per cent. of $42.80, the market value of twenty-six hundred pounds of a complete potato manure.*

An examination of the above table will indicate that the sweet potato crop was the principal source of the above profits, for the returns from the corn and millet did not pay for the potash salt, and the total value of the clover hay produced upon plot 4 would offer no inducement whatever, in general farming, to expend the time and money necessary to secure it. Combinations of potash, both with nitrogen and with phosphoric acid, when used upon corn and millet in one case, and upon clover hay in the other case, indicate results which might be called favorable were it not evident that the potato crop gave much more desirable returns. From one standpoint it may safely be claimed that all other crops in this rotation served merely as agents for holding the soil in suitable condition for the cultivation of sweet potatoes.

During a period of four years, Mr. Arnold used eighty tons of stable manure per acre, upon plot 11, and converted it into crops worth $177.82. During the same period, without the aid of fertilizers, a portion of the same field in the same crops, gave returns worth $55.30. The value of the manure may therefore be estimated at $122.52, or a fraction more than *one dollar and fifty cents per ton.* The manure, of course, caused a marked improvement in the fertility of the field, but the value of this improvement cannot at present be definitely expressed. To study this point, a second rotation has been commenced upon the same plots, its first crop, Indian corn, having been gathered in 1886 with the following results:

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.			
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Ears Good.	Pounds of Ears Poor.	Bushels of Shelled Corn Good.	Bushels of Shelled Corn Poor.
1	Nothing			840	90	11.2	0.9
2	Nitrate of Soda	150 lbs.	$4 05	1,310	190	17.5	1.9
3	Superphosphate	350 lbs.	3 67	930	210	12.4	2.1
4	Muriate of Potash	150 lbs.	3 00	940	170	12.5	1.7
5	Nitrate of Soda Superphosphate	150 350 } 500 lbs.	7 72	2,100	180	28.1	1.8
6	Nothing			970	220	13.0	2.2
7	Nitrate of Soda Muriate of Potash	150 150 } 300 lbs.	7 05	1,650	300	22.0	3.0
8	Superphosphate Muriate of Potash	150 350 } 500 lbs.	6 67	860	180	11.5	1.8
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 } 650 lbs. 150	10 72	2,290	170	30.5	1.7
10	Plaster	400 lbs.	1 50	500	170	6.6	1.7
11	Fine Barn-yard Manure	20 2-horse loads.	30 00	3,410	120	45.5	1.2

During the past five years each plot in the above experime
been dressed five times with the kind and quantity of fertilizer
in the above table. Per acre, therefore, plot 11 has received one
dred tons of stable manure; plot 9 has received 3,150 pounds
high-grade potato or corn fertilizer, and plot 3 has received
pounds of a plain superphosphate.

This is the second corn crop grown upon these experimental pl
the first having been harvested in 1882.

Nitrogen seems to have controlled the *grain development*, potas
phosphoric acid having been of little value when used either ab
combined, but noticeable improvements in yields, in each case, fol

stable manure, plot No. 11.

Nitrogen had but little effect upon stalk growth, in its influence in this direction being noticeably surpassed by both potash and phosphoric acid; plot 8, upon which these two elements of plant-food were used together, giving, without exception, the heaviest crop.

These results are practically identical with those from the College Farm experiment on corn, for 1886. Nitrogen, in this case, was also the ruling element in grain production, and of no practical value in increasing the weight of stalks.

The statement has been already made that the second rotation upon Mr. Arnold's plots was planned in the expectation that it would afford definite information regarding the storage of plant-food in the soil, one of the leading arguments in favor of using large amounts of manure and complete fertilizers being their effects upon subsequent crops. A comparison of the corn yield for 1882 with that for 1886 can now be drawn from the following tabulation. It is expected that the monthly record of mean temperatures and average rainfall for Vineland, since 1882, will be available for the next annual report:

Number of Plot.	FERTILIZERS.			YIELD PER	
	Kind.	Weight per Acre Used Annually in 1882, 1883, 1884, 1885 and 1886.	Annual Cost per Acre.	Bushels of Shelled Corn, 1882.	Bushels of Shelled Corn, 1886.
1	Nothing			15.8	12.1
2	Nitrate of Soda	150 lbs.	$4 05	22.7	19.4
3	Superphosphate	350 lbs.	3 67	15.0	14.5
4	Muriate of Potash	150 lbs.	3 00	13.7	14.2
5	Nitrate of Soda Superphosphate	150 350 } lbs.	7 72	20.7	29.9
6	Nothing			11.7	15.2
7	Nitrate of Soda Muriate of Potash	150 150 } lbs.	7 00	25.1	25.0
8	Superphosphate Muriate of Potash	350 150 } lbs.	6 67	14.4	13.3
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 } lbs. 150	10 72	23.1	32.2
10	Plaster	400 lbs.	1 50	13.8	8.3
11	Fine Barn-yard Manure	20 2-horse loads.	30 00	24.5	46.7

The crops of shelled corn grown in 1886 upon plots 1
are considerably larger than those gathered from the san
1882: the increase being 90 per cent. for plot 11, 28 per ce
9, and 44 per cent. for plot 5. In all other cases, exceptin
the yields for 1882 and 1886 are practically identical.

The influence of the weather upon these results is at p
known, and further comparisons will therefore be postpone

FIELD TRIALS WITH CANADIAN ASHES, DOMESTIC ASHES, DISSOLVED SOUTH CAROLINA ROCK AND ORCHILLA GUANO.

BY A. P. ARNOLD, VINELAND.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.							
				1885. Clover.			1886. Corn.				
	Kind.	Amount per Acre.	Cost per Acre.	Pounds. First Cut.	Pounds. Second Cut.	Total Weight.	Pounds of Ears, Good.	Pounds of Ears, Poor.	Bushels of Shelled Corn, Good.	Bushels of Shelled Corn, Poor.	Pounds of Stalks.
A	Canada Ashes.......	100 bu.	$36 00	1,380	1,360	2,740	2,760	90	36.8	0.9	6,020
B	Home Ashes..........	100 bu.	....	1,240	940	2,180	2,780	80	37.0	0.8	5,560
C	Dissolv. S. C. Rock..	1,000 lbs.	10 00	2,120	740	2,860	2,740	100	36.5	1.0	4,680
D	Orchilla Guano......	1,000 lbs	12 50	2,110	590	2,700	2,650	120	35.3	1.2	4,960

The above experiment was planned by Mr. Arnold, and will be carried through the rotation. The corn crop was not directly fertilized, but was grown upon the clover sod.

The above entries are made as a record simply, the consideration of the plan and its results being deferred until the trial is completed.

FIELD EXPERIMENTS WITH WOOL WASTE UPON WHEAT AND CLOVER.

BY THEO. WEST, COLLEGE FARM, NEW BRUNSWICK.

The primary object of this experiment, begun in the fall of 1883, was to determine the value of wool waste as a fertilizer for wheat.

In order to render the nitrogen of the wool waste more readily available, caustic potash was used as a solvent; but the experiment was so planned that the true effect of the caustic was not definitely proven. In 1884 the experiment upon wheat was planned to allow of a study of the following questions:

2. The effect of caustic potash in improving the quality of
in wool waste.

3. The relative effect upon wheat of caustic potash, ph
acid, and of nitrogen from wool waste.

The conclusions were as follows:

1. Favorable results were secured by the use of wool waste

2. The nitrogen of the wool waste was not increased in v
the treatment with caustic potash.

3. Both nitrogen and phosphoric acid exercised favorabl
upon the growth of wheat.

4. Potash, while it increased the weight of straw, did not
way affect the yield of grain.

The experiment this year upon clover is a study of the co
effect, under the same conditions, of the fertilizers applied upo
in the fall of 1884.

The plots were 12 feet wide and 363 feet deep—in area, th
one-tenth of an acre.

The dividing lines, or spaces between plots, were approx
18 inches wide.

The yields for 1885 and 1886, together with the details
experiment, are tabulated in the following table:

FIELD EXPERIMENTS WITH WOOL WASTE UPON WHEAT AND GRASS.

COLLEGE FARM, 1885, 1886.

Number of Plot.	FERTILIZERS.		Method of Application.	YIELD PER ACRE.		
	Kind.	Amount per Acre.		1885. Wheat.		1886. Hay.
				Pounds of Wheat.	Pounds of Straw.	Pounds of Hay.
1	Nothing			945	855	4,480
2	Caustic Potash	900 lbs.	Dissolve in water, mixed with coal ashes, and broadcasted.	955	1,645	6,830
3	Wool Waste	2,000 lbs.	Mixed with coal ashes and applied broadcast.	1,830	1,870	6,050
4	Caustic Potash Wool Waste	900 lbs. 2,000 lbs.	Caustic allowed to act in solution on wool waste for ten days, then mixed with ashes; applied broadcast.	1,850	1,500	6,224
5	Caustic Potash Wool Waste	900 lbs. 2,000 lbs.	Caustic dissolved in water, mixed with coal ashes and applied broadcast. Wool waste mixed with coal ashes and applied broadcast one day later.	1,610	2,240	6,417
6	Caustic Potash Wool Waste Bone-Black Superphosphate	900 lbs. 2,000 lbs. 350 lbs.	Caustic dissolved and soaked into wool waste and applied broadcast, superphosphate drilled with the seed.	1,480	1,620	7,516
7	Caustic Potash Wool Waste Bone-Black Superphosphate	900 lbs. 2,000 lbs. 350 lbs.	Wool waste and superphosphate applied one day later than caustic.	1,540	2,060	7,176
8	Caustic Potash Sulphate of Ammonia Bone-Black Superphosphate	900 lbs. 700 lbs. 850 lbs.	Ammonium sulphate and superphosphate applied one day later than caustic.	1,620	2,630	5,592
9	Wool Waste Bone-Black Superphosphate	2,000 lbs. 850 lbs.	Wool waste mixed with coal ashes and applied broadcast, the superphosphate drilled with the seed.	1,680	1,820	6,600
10	Caustic Potash Bone-Black Superphosphate	900 lbs. 850 lbs.	Caustic dissolved in water, mixed with coal ashes and applied broadcast, superphosphate drilled with the seed.	1,850	1,750	6,284
11	Bone-Black Superphosphate	350 lbs.	Drilled with the seed.	1,580	1,820	5,592

A comparison of plots 3 and 1 shows that wool waste increased the yield of clover 1,570 pounds; in combin phosphoric acid, a still larger increase is produced, while ir plete manure the increase reaches 2,700 pounds.

The Effect of Caustic Potash in Improving the Quali Nitrogen in Wool Waste.

The yields from 4, 5, 6 and 7 show a slight increase i the untreated waste on No. 5, and an increase in favor of t waste on No. 6.

If the caustic potash has been of any service in rend nitrogen of the wool waste more readily available, this ser small to pay the cost of the treatment.

The Relative Effects of Caustic Potash, Phosphoric Nitrogen from Wool Waste upon the Growth of Cl

Potash seems to have had the most marked effect of ingredients when used singly; wool waste was also effectiv ing an increase in excess of that from phosphoric acid.

A yield in proportion to the increase, when used singly, cured when the different fertilizers are used in combination 6 and 7.

The results from these experiments show that wool wa price at which this was secured, furnishes a very cheap nitrogen for these crops.

As the caustic potash had no favorable effect upon gen in the wool waste, its value depends entirely upon the actual potash it contains; kainite or muriate of potash fur element at a much cheaper rate.

FIELD TRIALS UPON INDIAN CORN, WHEAT AND RYE.

MADE TO TEST AND COMPARE

Various Forms of "Available" Phosphoric Acid.

The object and plan of the following experiments were given in detail in the last Annual Report of this Station, from which the following is quoted: "Agricultural chemists in the United States have recognized, for many years past, three distinct classes of phosphates:

"*First*—Those which dissolve in water.

"*Second*—Those which dissolve in neutral solutions of citrate of ammonia at temperatures not exceeding 100° Fahr.

"*Third*—Those which are insoluble in both of the above-named fluids.

"The phosphates included in the first and second classes are known to be of agricultural value whenever they are properly used upon suitable soils. Regarding those in the third class, however, it has been assumed until recently that their agricultural value was too low to be worthy of notice.

"Several years ago, at a convention held in Atlanta, Ga., a large number of chemists from different States created a fourth class, by isolating from the third all phosphates which dissolve in neutral solutions of citrate of ammonia at temperatures ranging between 100° and 150° Fahr. By adopting this test it was tacitly understood that phosphates which respond to it should rank with those in the first and second classes."

This change in an analytical method admitted the iron and alumina phosphates into the fertilizer trade.

The advantages promised by it were those which would naturally follow a very large increase in the supply of any product; its danger lies in grading a material higher than available facts justified.

The use of citrate of ammonia, at 150° Fahr., as a solvent in the analyses of phosphates, is illegal in New Jersey. Some dealers claim that serviceable brands are thereby either seriously depreciated in market value or even excluded from this trade. They therefore urge that this law should be repealed. This Station's officials believe that the matter should be investigated, and they have, therefore, carried out numerous field trials to determine the agricultural value of each of the four above-mentioned forms of phosphoric acid.

The materials used have been bone-black superphosphate, pre tated phosphate of lime, phosphoral and floats. Three of thes familiar commercial products; the following description of the fo viz., phosphoral, is reprinted from the last report:

"Phosphoral is a fertilizer containing neither nitrogen nor po It is made from iron and alumina phosphates by the action of sul and heat; the use of sulphuric acid or oil of vitriol being ent avoided in its preparation.

"The Tropic Guano Company, of New York City, donated n fifteen hundred pounds of this product to be used by this Stati field trials upon corn, turnips, wheat and rye.

"Its analysis, as copied from page 31 of Report for 1886, follows:

Phosphoric Acid.	Phosphoric Acid.	Phosphoric Acid.	Phosphoric Ac
Total.	Soluble in water.	Soluble in citrate of ammonia at 100° Fahr.	Soluble in citr of ammonia 150° Fahr.
Per cent.	Per cent.	Per cent.	Per cent.
49.40	......	4.61	32.65

"With less than five per cent. of phosphoric acid soluble at Fahr., and with nearly thirty-three per cent. soluble at 150° F phosphoral furnishes a striking illustration of a phosphate sta 'worthless' by one test and 'valuable' by a second; the diffe between the tests lying solely in the temperature employed."

Water dissolves practically all of the phosphoric acid in bone- superphosphate, but it has no solvent action upon the phosphoric either in floats, in phosphoral or in precipitated calcium phosp

The bone-black superphosphates therefore represent the first clas

Citrate of ammonia solution, at 100° Fahr., dissolves practi all of the phosphoric acid in precipitated calcium phosphates, an trifling solvent action only upon the phosphates in phosphoral a floats. *The precipitated calcium phosphates represent the second*

Citrate of ammonia solution, at 150° Fahr., dissolves a very percentage of the total phosphoric acid from phosphoral, and a percentage only from floats. *Phosphoral, therefore, may be taken representative of the class created by the Atlanta Convention,* floats represent those phosphates which dissolve neither in wate in citrate of ammonia at recognized temperatures.

Experiments have already demonstrated that soluble phosp results are secured, and cases are not wanting where positive assertions have been made regarding the profits which follow the use of the insoluble phosphoric acid in floats. Enough, therefore, is known to warrant the labor and expense involved in the following trials.

LOCATIONS OF EXPERIMENTS AND DESCRIPTIONS OF SOILS.

The farm of Arnold & Stephens is situated in Warren county, on the drained lands of the Pequest. The soil is a black muck, three feet deep, overlying sand. It was a fresh marsh until within the last two or three years. The hills adjacent are mostly of gneiss with a little limestone; a small portion of soil from these may have been washed down and deposited in this marsh. The muck is, however, almost all organic matter, and, when dry, burns freely.

The soil upon the College farm, near New Brunswick, consists largely of decomposed shale; it has been manured heavily for several years and is in a high state of cultivation.

Mr. Irons' farm lies near Manchester, in Ocean county; its soil is a light and rather fine sand, thin and naturally unproductive. It is very easy of tillage, and when marled and enriched, yields paying crops.

The farm of Mr. J. E. Parmly, near Oceanic, Monmouth county, is situated on the outer edge of the red sand bed of the marl formation. The soil is a sandy loam and is naturally rather deficient in the elements of plant-food, but it is susceptible of the highest degree of improvement by enrichment and cultivation.

The soil upon the farm of Ezra Dayton, Basking Ridge, Somerset county, is a heavy yellow loam, derived from the decomposition of igneous or trap rocks which probably underlie it. It is rather cold, but responds well to fertilization.

Rhutson Case, of Flemington, Hunterdon county, has a red sandstone soil, loamy, not very rich in mineral elements of plant-food, but containing much oxide of iron, and responding generously to fertilization. It is underlaid by red sandstone.

D. F. Pursel's land, near New Village, Warren county, is a yellow loam, a very fine soil, rich in mineral elements and underlaid by limestone.

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The results have been arranged in three tables:

TABLE I.

The crop returns from floats, phosphoral and precipitated phosphate of lime may be compared with each other, and with those from corresponding unfertilized plots.

Phosphoric acid, under these conditions, noticeably increased the crops of corn, rye and wheat. The only exception is found on the farm of Mr. Irons; here the results are irregular and their discussion will therefore be postponed.

Floats, in every case but one, failed to increase the crops of corn, rye and wheat.

Phosphoral was serviceable upon corn and rye, but it influenced the wheat crop in one instance only, that being upon the farm of Mr. Case, upon which the floats also offered an exception to their general rule.

Precipitated phosphate of lime caused an increased crop wherever it was used; in every case, too, its yields noticeably surpassed those from phosphoral.

TABLI

	Number of P
	Fertilizers Used per Acre.
	Kind and Quantity of Plant-food per Acre.
CORN.	
Arnold & Stephens	Ears of Corn
Independence, Warren co	Ears of Corn
	Stalks
RYE.	
Theodore West	Grain
College Farm, Middlesex co	Straw
WHEAT.	
J. H. Irons	Grain
Manchester, Ocean co	Straw
J. E. Parmly	Grain
Oceanic, Monmouth co	Straw
Ezra Dayton	Grain
Basking Ridge, Somerset co	Straw
Rhutson Case	Grain
Flemington, Hunterdon co	Straw
David F. Pursel	Grain
New Village, Warren co	Straw

TABLE II.

Floats, phosphoral and precipitated phosphate of lime were in every case mixed with precipitated sulphate of lime or land plaster. The crops raised with these mixtures may be compared with each other and with the returns from the bone-black superphosphate. The crops from all four phosphates may also be compared with those from corresponding plots, dressed with plaster only.

Phosphates mixed with plaster and used on corn and rye increased the yields over those from plaster alone; when used upon wheat, however, plaster, in three cases, yielded larger returns than the phosphates—a result which demands close investigation.

Floats mixed with plaster was without effect upon corn; upon rye, it indicated a slight increase; upon wheat, in three cases, its crops were smaller than those from plaster alone, and in two cases its increased yields were without practical significance.

Phosphoral, mixed with plaster, was useless upon corn, but upon rye it gave a very favorable result. On wheat, in three cases, its yields were less than plaster alone produced; in one case, it was not quite as serviceable as floats, and in one case it increased the crop by, roughly, three bushels of grain per acre.

Precipitated phosphate of lime, when mixed with plaster, had no marked influence on corn; on rye it caused a very large increase in grain, surpassing all other forms of phosphates; on wheat, in three cases, its crops were surpassed by those from plaster alone. In every case, however, it was noticeably superior to floats and phosphoral, and it was surpassed in one case only by bone-black superphosphate.

Bone-black superphosphate used on corn excelled all other forms of phosphoric acid. On rye it is less serviceable than either phosphoral or precipitated phosphate of lime. On wheat it surpassed floats in every case, and phosphoral in every case save one, in which the results were identical. In one instance it gave larger returns than the precipitated phosphate by, roughly, three bushels of grain per acre. In two cases its crops were practically identical with those from the precipitated phosphate, but in two cases it was clearly of less value agriculturally than this phosphate.

Without exception either bone-black superphosphate or precipitated phosphate of lime has given the largest returns, but the above data are not sufficient to decide that one of these two sources of phosphoric acid is superior to the other.

TABLE

Number of Plot.

Fertilizers Used per Acre.

Kind and Quantity of Plant-food per Acre.

CORN.	
Arnold & Stephens....................	Ears of Corn Goc
Independence, Warren co......	Ears of Corn Poo
	Stalks................
RYE.	
Theodore West............................	Grain.................
College Farm, Middlesex co...	Straw.................
WHEAT.	
J. H. Irons.................................	Grain.................
Manchester, Ocean co.............	Straw.................
J. E. Parmly..............................	Grain.................
Oceanic, Monmouth co..........	Straw.................
Ezra Dayton..............................	Grain.................
Basking Ridge, Somerset co...	Straw.................
Rhutson Case............................	Grain.................
Flemington, Hunterdon co....	Straw.................
David F. Pursel.........................	Grain.................
New Village, Warren co.	Straw.................

TABLE III.

Nitrogen and potash were, in each case, added to the mixtures already discussed under table II. Four complete fertilizers were thereby formed, which differ from each other only in the *quality* of their phosphoric acid.

Under these conditions, when used on corn, the floats, the precipitated phosphate of lime and the bone-black superphosphate were almost identical in their results, indicating that either potash or nitrogen may have been the true cause of the very marked increase which followed the use of these fertilizers.

On the rye crop, also, other conditions seem to have exercised greater influence than the phosphates; the soluble phosphoric acid, however, excels, and the grain from the other three phosphates is practically identical in weight.

Mr. Irons' report indicates that all four complete fertilizers were, in effect, of equal value on his wheat, and largely increased the crop, but in the other wheat experiments, those fertilizers with soluble and precipitated phosphates give larger crops than those made from the phosphoral and floats. In two cases the soluble phosphoric acid excels the precipitated phosphate of lime, but in two cases the precipitated phosphate gives the highest yields.

Floats and phosphoral are also practically identical in their effects upon wheat, the slight differences being in favor of phosphoral.

CONCLUSIONS.

It was hoped that the results from this series of experiments would be definite; it is now evident, however, that they can be regarded as indications merely, not as positive proof.

They give to the precipitated phosphate of lime, soluble in citrate solution at 100° Fah., a higher rank than it occupies in the minds of many chemists, making it practically equal, in agricultural value, to those phosphates which readily dissolve in water.

The results also create an impression that the phosphoric acid, in phosphoral, which dissolves in citrate solutions at temperatures ranging from 100° to 150° Fahr., is more valuable, agriculturally, than that in floats which does not yield to this treatment. They do not, phosphates and precipitated phosphates of lime.

Other experiments on grain are now in progress, to study this question still further. If they are finished without accidents, they will be reported in due season.

FIELD EXPERIMENTS WITH FERTILIZERS ON PEACH TREES.

BY STEPHEN C. DAYTON, BASKING RIDGE, SOMERSET COUNTY, N. J.

Number of Plot.	FERTILIZERS.			Average Height of Trees per Plot in Feet.	Number of Peaches per Plot.	Weight of Peaches per Plot in Pounds.	Weight of 3 Largest Peaches in Each Plot in Pounds.
	Kind.	Weight per Acre.	Cost per Acre.				
1	Nothing	....	....	8.65	4	....	....
2	Nitrate of Soda	150 lbs.	$4 05	8.71	10	2.3	0.8
3	Superphosphate	350 lbs.	3 67	9.81	25	7 0	1.2
4	Muriate of Potash	150 lbs.	3 00	8 81	3	1.0	1.0
5	Nitrate of Soda Superphosphate	150 350 } 500 lbs.	7 72	9.96	46	13.0	1.4
6	Nothing	....	....	9.00	12	3.0	1.0
7	Nitrate of Soda Muriate of Potash	150 150 } 300 lbs.	7 05	9.25	3	1.0	1.0
8	Superphosphate Muriate of Potash	350 150 } 500 lbs.	6 67	9.86	14	3.3	1.0
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 } 650 lbs. 150	10 72	10.10	16	4.1	1.0
10	Plaster	400 lbs.	1 50	9.56	12	3.3	1.0
11	Fine Barn yard Manure	20 2 horse loads.	30 00	10.50	11	3.0	1.0
12	Barn-yard Manure Lime	10 loads 50 bushels	....	9.56	....	....	....

year and followed in 1885 by buckwheat. No field cro on these plots in 1886. The ruling fertilizing elemen farm for grain and grass has been phosphoric acid. Pea planted April 24th, 1884, accurate measurements of th made in November, 1886, and are published this year matter of record.

The cultivation and treatment of the orchard during th is clearly stated in the report of Mr. Dayton:

"The plots were plowed in April, as early as the gr good condition, the fertilizers sown and harrowed in, and ing repeated to keep down the weeds and stimulate the g trees. The trees were trimmed early in June, the gro again early in July and harrowed, after which the weeds

"The main branches of the trees have made a growth from three feet to four feet three inches in length, a exceptions are in a healthy and thrifty condition. Th plot 4 and one in plot 3 were girdled by the mice an replaced by young trees.

"The trees on plot 6 show that this ground, producing tilizers only ten bushels of buckwheat in a fair season, wi care, grow peach trees to the age of fruit-bearing, in as thrifty a condition as could be desired; and it is also no while superphosphate has increased the growth of stra three or four-fold, it has increased the growth of the trees three years."

FIELD EXPERIMENTS WITH FERTILIZERS ON RED CLOVER.

BY J. M. DALRYMPLE, HOPEWELL, MERCER CO., N. J.

Number of Plot.	FERTILIZERS.			Pounds per Acre.	Gain or Loss per Acre in Pounds.	Net Profit or Loss per Acre.
	Kind.	Weight per Acre.	Cost per Acre.			
1	Nothing....................	....	....	2,850	....	....
2	Nitrate of Soda............	150 lbs.	$4 05	3,750	+700	—$0 55
3	Superphosphate............	350 lbs.	3 67	2,900	+50	—3 42
4	Muriate of Potash.........	150 lbs.	3 00	4,650	+1,600	+5 00
5	Nitrate of Soda............ Superphosphate............	150 350 } 500 lbs.	7 72	5,350	+2,300	+3 78
6	Nothing....................	....	....	3,250	....	....
7	Nitrate of Soda............ Muriate of Potash.........	150 150 } 300 lbs.	7 00	5,350	+2,300	+4 50
8	Superphosphate .... Muriate of Potash.........	350 150 } 500 lbs.	6 67	5,350	+2,300	+4 83
9	Nitrate of Soda........... Superphosphate.. .... Muriate of Potash........	150 350 } 650 lbs. 150	10 72	6,250	+3,200	+5 28
10	Plaster........................	400 lbs.	1 50	2,900	—150	—2 25
11	Fine Barn yard Manure..	20 2-horse loads.	30 00	5,050	+2,000	—20 00

This is the third experiment in the rotation. The season throughout was favorable for growing clover.

All fertilizing materials except plaster exerted a favorable effect.

Nitrogen and potash are the ruling elements.

Superphosphate seems to have exerted but little influence when used alone, but when used in combination with nitrogen or phosphoric acid, or as a complete manure, its effect is quite as marked as that of nitrogen or potash. The barn-yard manure increased the yield by complete manure, and by the combinations used upon plot

Muriate of potash alone produced a net profit of $5 p profit is only increased by twenty-eight cents on the addit gen and phosphoric acid in the complete manure. The a of $20 per acre from the use of barn-yard manure wo indicate that profit from increased yields must come thr of chemical fertilizers.

FIELD EXPERIMENTS WITH FERTILIZERS

BY N. S. SERGENT, SCHOOLEY'S MOUNTAIN, HUNTERDON COUNT

Number of Plot.	FERTILIZERS.			YIELD PER A	
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Grain.	Bushels of Grain.
1	Nothing			1,120	20.0
2	Nitrate of Soda	150 lbs.	$4 05	1,100	19.6
3	Superphosphate	350 lbs.	3 67	1,720	30.7
4	Muriate of Potash	150 lbs.	3 00	1,010	18.0
5	Nitrate of Soda Superphosphate	150 350 500 lbs.	7 72	2,200	39.30
6	Nothing			1,160	20.7
7	Nitrate of Soda Muriate of Potash	150 150 300 lbs.	7 00	1,080	19.3
8	Superphosphate Muriate of Potash	350 150 500 lbs.	6 67	1,880	33.6
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 650 lbs. 150	10 72	2,070	37.0
10	Plaster	400 lbs.	1 50	1,320	23.6
11	Fine Barn-yard Manure	20 2-horse loads	30 00	2,050	36.6

The yields from the unmanured plots for the three years indicate a high state of fertility.

EFFECT OF FERTILIZERS.

Nitrate of soda and muriate of potash were of no effect, either when used alone or in combination with each other.

Superphosphate largely increased the yield of both grain and straw. The highest yield of grain was secured when used in combination with nitrate of soda upon plot 5, and the largest yield of straw from the complete manure on plot 9.

Plaster increased the yield of grain 3.6 bushels and of straw 590 pounds.

The increased yield from the use of barn-yard manure upon plot 11 was excelled by that from both 5 and 9, and almost equaled by that from 8, upon which phosphoric acid and potash were used in combination.

PROFIT AND LOSS.

A loss was entailed by the use of nitrate of soda and muriate of potash, both alone and in combination with each other.

The large increase in yield produced by barn-yard manure was secured at an apparent loss of $8 per acre.

Superphosphate was profitable wherever used; the greatest profit, $17.71 per acre, was secured from nitrogen and phosphoric acid on plot 5.

Plaster was also profitable.

upon any of these plots. In order to continue the experiment through the rotation, clover seed was again sown and lightly harrowed.

Observations taken May 24th, 1886, showed a fair stand upon plots 4, 7, 8, 9 and 11; the remaining plots ranged from very poor upon plot 1 to fair upon plot 10. The crop was harvested June 28th, and weighed in good condition June 30th; the weights then recorded correspond very closely with the observations taken in May.

It is evident that this result was largely due to the favorable effect produced by the muriate of potash in securing a stand, since, with the exception of plot 11, the crop was very light where no muriate of potash was used.

The unmanured land, in this experiment, does not seem to be strictly uniform in fertility; in 1884 the largest yield was secured from No. 6; in 1885 No. 1 was slightly ahead, and for this crop No. 6 is again superior.

In the computations which follow the product from No. 6 is taken as representing the fertility of the unmanured land.

Regarding $10 per ton as the price for mixed hay, No. 4 yielded a net profit of $6 per acre; No. 7, a profit of $5.50; No. 8, $7.33, and No. 9, $9.28.

expenses incurred in stripping them from the cane.

Most of these points have been noticed in the report of the past season's work, printed in detail upon the following pages.

THE EXTRACTION OF SUGAR FROM SORGHUM, AT RIO GRANDE, CAPE MAY COUNTY, NEW JERSEY.

In 1883, Messrs. Geo. C. Potts & Co., lessees of the Rio Grande Plantation, attempted to secure an increased yield of juice from sorghum by the use of a supplementary mill. After one season's work this attempt was abandoned, and a diffusion battery was substituted in which to work bagasse. The sugar was then thoroughly extracted, but in such an impure condition that, after a comparatively short trial, this process was also abandoned.

In 1885, diffusion was again tested. As the result of twenty-six days' work, two hundred and twenty-nine barrels of molasses were made from a portion only of the mill bagasse. This molasses was graded low, both in color and taste; it was sold, however, for considerably more than it cost, and demonstrated to the satisfaction of practical men that a first-class cane mill can be an extremely wasteful machine.

Meanwhile Superintendent Hughes and the chemist of this Station were experimenting at Rio Grande, upon a small scale, their aim being:

1. To compare mill juice from unstripped cane with diffusion juice from thoroughly clean stalks.

2. To compare the diffusion juices from stripped and unstripped sorghum.

The results were as follows:

1. Eighty-nine per cent. of the total sugar in the cane was secured by diffusion. Forty-eight per cent. of the total sugar in the cane was secured by milling. Mill products, therefore, must be increased by eighty-four per cent. in order to equal diffusion products.

2. Diffusion juices from stripped cane excel mill juices from unstripped cane in concentration, color, taste and purity. Diffusion juices from unstripped cane are inferior to mill juice in all of these respects.

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1. The need of utilizing diffusion bagasse in the preparation of paper pulp.
2. The need of developing methods for storing cane for use during the winter.
3. The probability that financial success can be attained if a sugar-house is properly equipped for working sorghum.

The detailed descriptions and results have been arranged in the following order:

I.

A DESCRIPTION OF THE METHODS ADOPTED AT RIO GRANDE FOR EXTRACTING SUGAR FROM SORGHUM.

II.

A DETAILED REPORT OF THE PAST SEASON'S WORK.

III.

THE CHANGES AND IMPROVEMENTS NEEDED IN ORDER TO INCREASE RECEIPTS AND DIMINISH EXPENSES.

IV.

FINANCIAL CONSIDERATIONS.

The report of this Station for 1884 contains a history of the Rio Grande Sugar Plantation, but in this history brief mention only is made of the details of the method by which sugar is extracted from cane juices and converted into merchantable forms. A full account of this process is now necessary in order to simplify the report of the past season's work.

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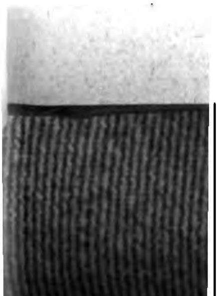

separation of seed tops from the unstripped cane has been found to be thoroughly satisfactory.

The four-inch sections of cane mixed with leaves, but practically free from seed, are elevated to a fan which blows away much of the leaf, and wastes under favorable conditions very little or none of the stalk. Two small knives, each revolving nearly two thousand times per minute, next shave these cleaned sections into chips and the cane is then ready for diffusion.

Diffusers are simple air-tight vessels or cells made of boiler iron, with a convenient arrangement of pipes for water, steam and juice. The report of this Station for 1885 contains the following description:

> "At Rio Grande there are ten diffusers, each of which has a capacity of seventy-two cubic feet, and consequently can hold forty-five hundred pounds of water.
>
> "When in operation each of these cells should be packed with finely-cut sorghum and closed air-tight; water should then be forced in through the bottom of the first cell until it flows from the air-cock at the top. In passing through this cell the water takes up a very large portion of the total sugar stored in the cane, but the solution is too dilute to admit of economical working; it is, therefore, slowly forced in succession through the cane in the remaining nine cells, and when finally discharged it should be nearly as concentrated as mill juice.
>
> "Water fills the first cell whenever dilute juice is forced into the second, third or following cells, consequently when the juice flows from the last diffuser, the cane sections in the first will have been extracted ten times with pure water and should then contain traces only of sugar. This extracted cane is called diffusion bagasse and is removed to the compost field. Cell No. 1 is then refilled with fresh sorghum and becomes No. 10 in battery. When the contents of cell No. 2 have been leached ten times with water and dilute juice, this cell is also cleaned and refilled with fresh sorghum. As each following cell in turn is treated in a similar manner the process is made continuous."

2.

CLARIFICATION.

Normal cane juice secured either by milling or by diffusion is acid in reaction, and in addition to sugar contains a number of compounds, some of which are simply suspended in the water, while others are in solution. The amount of suspended matter is variable, depending largely upon the carefulness of a single workman.

termed clarification.

Four copper caldrons, called clarifiers, each holding five hundred and fifty gallons, are used for this work. Each clarifier is enclosed in a steam-jacket properly provided with safety-valves, drip-cocks and all other attachments necessary for rapidly handling cane juice and heating it to its boiling point. For convenience in removing scum, &c., the clarifiers are supported upon a platform six feet above the ground. A force pump is used in filling them with mill juice, but the water pressure, with which the battery is operated, is strong enough to raise the diffusion juice to the necessary level.

About five hundred gallons of juice are taken for each clarification. It is first treated, to nearly neutral reaction, with freshly slacked lime, mixed in water to a fine whitewash; then steam is turned into the jacket and the temperature allowed to rise to 190° Fahr., at which point a sufficient amount of yellow lime* is added. By this time the surface will be covered by a grayish-white scum, more or less heavy, according to the quality of the juice. As soon as this scum breaks, showing a pure white foam, the steam is shut off, as the temperature then will be not far from 210° Fahr. Within half an hour the heavier precipitate which also forms will have subsided, and the clear juice may be drawn off. After the scum and precipitate have been washed into a settling tank, the clarifier will be ready for another charge.

3.

EVAPORATION.

For each pound of sugar present in cane juice there is, roughly, ten pounds of water, nearly all of which must be boiled away before the sugar can be secured in merchantable forms. The apparatus for this work is arranged in the third story of the building and consists of four open evaporators, one double-effect vacuum and two ordinary vacuum pans. The double-effect was not used during the past season because of a scarcity of water for condensation purposes.

Vacuum pans are strongly-constructed air-tight vessels of iron or copper, connected with powerful air pumps and fitted with steam coils, condensers, thermometers, proof-sticks, &c. The principle upon boils or changes into steam at 212° Fahr. when heated in open vessels, changes into steam at 70° Fahr., and lower, if heated in a perfectly tight flask absolutely free from air and all other gases. Syrup, which boils at 220° Fahr. in an open evaporator, boils at 120° Fahr. in a good vacuum pan, and all risks of burning or inverting its sugar are thereby avoided.

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* Made by saturating cream of lime with sulphur fumes. (Sulphurous acid gas.)

The cane juice, warm from the clarifiers, is pumped into the open evaporators; here five hundred gallons of juice are quickly concentrated to two hundred and fifty gallons. This product is then drawn into a small vacuum pan and boiled down to, approximately, one hundred gallons. Successive charges from the evaporators are similarly treated, until this vacuum pan contains perhaps eight hundred gallons of a concentrated product indicating 55°–60° Brix, equivalent to 30°–33° Baume. This is known as "feed for pan;" it is allowed to flow from the vacuum into a tank upon the second floor.

SEPARATION OF SUGAR FROM MOLASSES.

The "feed for pan," although it is very concentrated, still contains enough water to hold in solution all of the sugar secured from the cane, as well as many impurities which resist clarification. This water must, therefore, be evaporated, but in such a manner that the sugar may be secured in uniform crystals of a proper size, and thus be separated from the impurities which remain in the semi-fluid product called molasses.

Briefly, this is done in the following manner: Several hundred gallons of the "feed for pan" are drawn into the large vacuum pan, and there concentrated until the sugar separates in minute crystals known as "sparks." These are visible only when samples are drawn from the pan by means of the proof-stick, and allowed to flow over a small plate of glass. The sugar boiler then aims to increase the size of the "sparks" until they become "grains." He does this by drawing small quantities of the pan feed, every few minutes, into his pan, at the same time carefully regulating the vacuum and heat. If too much feed is drawn in, it dissolves the crystals, and a part of the work must be repeated; if, on the other hand, the evaporation is too rapid, new sparks and small grains will form, giving crystals of various sizes in the same pan, and preventing or seriously hindering a ever, easily avoid both dangers, and in a very few hours conce in a single pan all that is valuable to the sugar industry in a hu tons of cane.

The contents of the pan, now called melada, are allowed to ru into small iron tanks placed on wheels, and known as sugar w each of which holds, approximately, 2,600 lbs. These are rolle a room in the second story of the building, in which the tempe varies only between 110° and 120° Fahr. The melada remains these conditions from eight to ten days, during which time the crystals increase somewhat in size. At the close of this perio wagons are emptied into the mixer, whence the melada is draw the centrifugal machines located upon the first floor of the hous

If the sugar boiler has had juice of good quality and has ma his pan so that uniform crystals of a proper size only have fo then the separation of these crystals from the molasses is effected, and the sugars "run dry" in a very short time. I grain has formed in the pan, or if the juice was "gummy," th machines may run almost indefinitely without removing the mo This molasses flows from the centrifugals into underground tan the sugar must be removed from the machines by hand, then g in a mill and immediately packed into hogsheads holding 2,0 each. The tanks are emptied daily, the molasses being first d to 38° Baume, and then drawn into barrels ready for shipment.

Lime kilns, carbonic acid pumps, filter presses and bone filters, with the expensive arrangements for purifying and keepi bone-black in proper order, are not included in the equipment house. Those who are familiar with the sugar beet industr therefore, conclude that proper results can hardly be expected such a plant. In reality, however, with very few changes, thi can secure in merchantable forms ninety per cent. of the total present in sorghum.

II.

THE RESULTS OF THE PAST SEASON'S WORK AT RIO GRANDE.

1. *Milling and diffusion under ordinary conditions.*
2. *Comparison of the results.*
3. *Diffusion under unfavorable conditions.*

1.

MILLING UNDER ORDINARY CONDITIONS.

The concentration and purity of mill juice both before and after clarification and evaporation.

The yields of sugar and molasses from mill juice.

The losses of sugar in the scum and mill bagasse.

On the 4th, 5th and 6th of October, a crop of Kansas orange sorghum was harvested from one-half of a large field; the crop upon the other half was reserved for a future experiment. The yield was *three hundred and ninety-four tons two hundred and ninety-six pounds* of unstripped and untopped cane, from which the mill extracted twenty-nine thousand five hundred and eighty gallons of juice, or *seventy-five gallons per ton.* Eight tons only were ground upon the 4th inst., but one hundred and ninety-three tons daily were worked upon the 5th and 6th inst.

THE CONCENTRATION AND PURITY OF MILL JUICE BOTH BEFORE AND AFTER CLARIFICATION AND EVAPORATION.

The juice from the above cane was collected in a storage tank, whence it was pumped from time to time into the clarifiers, each of which was filled to a mark indicating 510 gallons. Its treatment at this stage has been already described.

Each clarifier was sampled both before and after clarification; the average analyses of the samples in each case were as follows:

	Sugar.	Brix at 14°.	Purity.
Before clarification...............	8.93 per cent.	12.99	68.75
After "	9.12 "	13.17	69.19

This comparison indicates that the purity of the crude was not materially improved by the clarification. The v scum removed nearly all of the suspended matter, but it relatively, only a very small amount of the soluble impurit

After the clarified juice had been concentrated in the op rators and small vacuum, the resulting "feed for pan" ave

Sugar.	Brix at 14°.	Purity.
40 per cent.	59.33	67.42

The following proportion indicates what the pan feed, above conditions, should have tested:

Brix of purified juice.		Brix of feed for pan.		Per cent. of sugar in juice.		Calcula per cent. o in pan f
13.17	:	59.33	: :	9.12	:	41.0

Instead of 41.08 per cent., the analysis indicated only 40 making it appear that a small quantity of sugar had been i the open evaporators.

THE YIELDS OF SUGAR AND MOLASSES FROM MILL J

The melada from this "feed for pan" filled sixteen suga and was at once recognized as superior in quality. Eight d was passed through the centrifugal machines and yielded thousand four hundred pounds of 83 test sugar and seven dred gallons of 39° Baume molasses, or thirty-six and t pounds of 83 test sugar and four and one-third gallons o per ton of unstripped and untopped cane.

The four and one-third gallons of molassess weighed, mately, forty-nine and one-half pounds, and tested by method 32.7 per cent.; consequently, the mill molasses ton of unstripped and untopped cane contained sixteen and ter pounds of 100 test sugar.

The crystallized product obtained, viz., thirty-six and pounds per ton, was 83° test, hence it represented only t four-tenths pounds of 100 test sugar.

4.33 gallons molasses contain.....	16.25	pounds	100	test su
36.6 pounds of 83 test represent..	30.40	"	"	"
Total..............................	46.65	"	"	"

Google

seven-tenths pounds of 100 test sugar, of which 65 per cent. crystallized and 35 per cent. remained in the molasses.

LOSSES OF SUGAR IN THE SCUM AND MILL BAGASSE.

The following calculations indicate that, on the average, each ton of the unstripped and untopped cane used in this milling trial contained one hundred and fourteen pounds of 100 test sugar, viz., 2,000 pounds of unstripped and untopped sorghum include 500 pounds of leaf and seed and 1,500 pounds of clean cane; of this clean cane, 85 per cent., or 1,275 pounds, is juice, uniform in composition with that extracted by the mill. This juice has been shown to contain 8.93 per cent. of sugar; hence, one ton of unstripped and untopped cane contained one hundred and fourteen pounds of 100 test sugar (1,275 pounds × 8.93 per cent.)

The mill products, viz., merchantable sugar and molasses, have been shown to represent forty-six and seven-tenths pounds of 100 test sugar; hence, there must have been wasted in mill bagasse and scum (114 — 46.7) sixty-seven and three-tenths pounds of 100 test sugar, or 59 per cent. of the total amount produced in the field.

1.

DIFFUSION UNDER ORDINARY CONDITIONS.

Stripping and topping cane.
Manipulation of the diffusion battery.
Concentration and purity of diffusion juices both before and after clarification and evaporation.
Yields of sugar and molasses by diffusion.
Losses of sugar in the waste products from the battery.

The crop upon the second half of the field of Kansas orange sorghum and a portion of the crop from an adjoining field in Early Orange cane were harvested during the period October 9th to October 23d. The yield was seven hundred and twenty-seven tons eighteen hundred and eighty-nine pounds of unstripped and untopped cane.

This was stripped and topped as described in the previous chapter and then diffused.

STRIPPING AND TOPPING CANE.

On the twentieth of October a test was made to determin in weight suffered by cane during the process of stripping ar Thirty-six tons were found to lose nine thousand two hundr or 12.8 per cent., by the removal of seed tops, and five tho hundred and thirty-five pounds, or 8.24 per cent., by remov and sheaths. The cane, therefore, when it reached the di reduced in weight by twenty-one per cent.

MANIPULATION OF THE DIFFUSION BATTERY.

The records show that four hundred and fifty-five tons of and untopped cane were worked during a given period, an hundred and fifty-six diffusers were filled; with the above of twenty-one per cent. for leaves, sheaths and seed tops, ea therefore averaged *fifteen hundred and seventy-six* pounds cane. This cane was by no means entirely free from le amount present, however, appears to have been too small any way the color and taste of the diffusion products.

The diffusers were worked at about 60° R., and each approximated two hundred gallons of juice.

CONCENTRATION AND PURITY OF DIFFUSION JUICES BOT AND AFTER CLARIFICATION AND EVAPORATIO

Samples of the diffusion juice were drawn from each cl before and after clarification. The average results, in ea eleven analyses, are as follows:

	Sugar.	Brix at 14° R.
Before clarification............	7.59 per cent.	11.56
After "	7.63 "	11.62

Clarification seems to have been almost entirely without diffusion juices, for the scum and sediment combined, from five hundred and ten gallons, amounted to less than a pailf frothy material. The chips of cane and the iron grati diffusers evidently act as a filter, by which suspended imp removed. This clarified diffusion juice was boiled down i sampled and analyzed daily.

The average of eight analyses was found to be:

Sugar.	Brix at 14° R.	Purity.
38.30 per cent.	55.40	69.10

A calculation similar to that made in the case of mill juice brings out an interesting, but probably well-known fact, viz., that under certain conditions, juices increase in purity during evaporation, owing probably to the precipitation of salts of organic acids.

Brix of purified juice.		Brix of feed for pan.		Per cent. of sugar in juice.		Per cent. of sugar in feed for pan.
11.62	:	55.40	: :	7.63	:	36.39

The calculated per cent. of sugar is found to be 36.39; the actual analysis indicates, however, 38.30 per cent., hence it follows that the Brix 55.40 is not as high as the evaporation requires on the supposition that no loss of solid matter occurred during the process; another proportion indicates, however, that in all probability such a loss actually took place.

Per cent. of sugar in diffusion juice.		Per cent of sugar in feed for pan.		Brix in diffusion juice.		Calculated Brix in feed for pan.
7.63	:	38.30	: :	11.62	:	58.3

Had no such change or loss occurred, instead of the actual Brix 55.40 the reading would have been 58.3.

WORKING WITHOUT THE USE OF CLARIFIERS.

The absence of all noticeable results from the attempts to clarify diffusion juice led to a trial of the effect of working without clarification.

The yellow lime was added in small quantities to the chips as they fell into the diffusers, in order to prevent any possible souring or inversion in the battery; the use of slacked lime was for the time abandoned.

The juice was forced into the clarifiers and sampled as usual. It was then raised to the boiling point and again sampled. The feed for pan secured by boiling down this juice was also carefully examined.

The results are as follows:

	Per cent. of sugar.	Brix at 14°.	P
Diffusion juice before heating...........	7.80	11.87	6
" " after "	7.85	11.87	6
"Feed for pan" from above juice......	39.20	56.97	6

As far as can be seen, the above data fail to indicate any whatever in the use of freshly slacked lime.

The use of white and yellow lime in the clarifiers was, abandoned for a time without any unfavorable consequences.

The unwillingness to accept the responsibility of so radi without ample opportunities for closely studying the resul however, a return to the old process.

YIELDS OF SUGAR AND MOLASSES BY DIFFUSION.

The melada from the diffusion juice filled forty-five suga and was, in all respects, a very satisfactory product.

After the usual time in the "hot room" this melada yielde pounds of 83 test sugar and 5,656 gallons of 38 Baume equivalent to *sixty-seven and one-tenth* pounds of 83 test s *seven and eight-tenths* gallons of molasses for each ton of u and untopped cane.

On the basis of stripped and topped cane, these yields ar lent to *eighty-five* pounds of sugar and *ten* gallons of molasses

An analysis of a sample representing the total yield of viz., 5,656 gallons, proved that this molasses contained 26.6 of chemically pure sugar.

As seven and eight-tenths gallons weighed eighty-seven a tenths pounds, it follows that the diffusion molasses from o unstripped and untopped cane contained *twenty-four and t* pounds of 100 test sugar.

The sixty-seven and one-tenth pounds of 83 test sugar r fifty-five and seven-tenths pounds of 100 test sugar.

Therefore, each ton of unstripped and untopped sorghum to diffusion seventy-nine and nine-tenths pounds (24.2 + 55. test sugar, of which 69.7 per cent. crystallized and 30.3 remained in the molasses.

Of the seven hundred and twenty-eight tons of sorghum used in the diffusion trial, three hundred tons came from the field from which the cane used in the milling experiment had been secured.

This, it will be remembered, averaged *one hundred and fourteen* pounds of 100 test sugar per ton.

The remaining four hundred and twenty-eight tons, harvested from a neighboring field, were of the Early Orange variety. Its quality was tested in the following manner:

Small portions of the stripped, topped and shredded cane were picked from the carrier during the time occupied in filling five diffusers; about fifty pounds were secured in this manner, from which a sub-sample was drawn; this was dried at 120° Fah., ground to a flour and extracted with boiling alcohol.

The alcoholic extract, properly purified and polarized, indicated that one ton of unstripped and untopped cane contained *one hundred and twenty pounds of 100 test sugar.*

For practical purposes, therefore, it is safe to assume that the entire lot of seven hundred and twenty-eight tons of cane used in the diffusion trial averaged not less than *one hundred and fourteen pounds* of 100 test sugar per ton.

Of this *one hundred and fourteen pounds* the diffusers secured *seventy-nine and nine-tenths pounds.* The diffusion bagasse and the waste-water from the battery must, therefore, have contained at least *thirty-four and one-tenth* pounds, or 30 per cent. of the total sugar produced in the field.

2.

A COMPARISON OF THE RESULTS SECURED BY MILLING AND BY DIFFUSION.

The relative concentration and purity of the juices.
The relative quantity and quality of the products.
Conclusion.

THE RELATIVE CONCENTRATION AND PURITY OF THE JUICES.

	Per cent. Sugar.	Brix at 14°.	Purity.
Mill juice before clarification...............	8.93	12.99	68.75
Diffusion juice before clarification........	7.59	11.56	65.57

DIFFUSION UNDER UNFAVORABLE CONDITIONS.

During the week ending October 30th, four hundred and twenty tons and seven hundred and sixty pounds of unstripped and untopped cane were charged against the sugar-house.

The weather during two days of this week was bright and fair, but it was necessary to cut the cane in the fields before the heavy dew had evaporated. Rain fell incessantly upon the other four days. The work, however, was pushed forward as usual. The result was:

1st. That the sorghum was cut and loaded while dripping wet, and then drawn several miles to the scales in pouring rain. The recorded weights, therefore, are no indication of the amount of clean, dry cane delivered at works.

2d. The leaves, wet either with dew or rain, matted and tangled the cane sections so that the fan worked under disadvantages. The wet leaves also clung to all exposed surfaces and necessitated a stronger air blast to remove them; this increased the mechanical losses of cane, many of the lighter pieces being carried away with the leaves. In spite of the increased air blast much leaf was also carried into the diffusers, not only occupying the space which should have been filled with cane, but also blackening the diffusion juice and imparting to it a peculiar "tea" taste and smell.

It required *four hundred and forty-eight* diffusers during this week to work the cleaned product from *four hundred and twenty* tons of wet unstripped and untopped sorghum, when *four hundred and twenty* diffusers were sufficient for *four hundred and twenty* tons of cane under ordinary circumstances.

During this period, the average composition of the feed for pan was:

Per cent. of sugar.	Brix at 14°.	Purity.
33.01	57.33	57.6

The melada from this product was thoroughly unsatisfactory, the sugar boiler having experienced the greatest difficulty in securing grains and handling his pan. In the "hot room," the contents of the sugar wagons remained soft, and when this melada was worked through the centrifugal machines the yields of sugar were very small, being only *forty-four and three-tenths* pounds of 83 test per ton of

cane. The molasses yield was, of course, correspondingl
amounting to *eight and three-tenths* gallons per ton.

Owing to the unfair conditions under which the cane w
and also because of mechanical losses of cane sections
fanning process, the above record of yields per ton ha
absolute significance. Relatively, however, they are of v
interest.

The molasses, viz., eight and three-tenths gallons, weig
four and one-half pounds, of which 26.6 per cent., or
and two-tenths pounds, was found to be chemically pure s

The crystallized product, viz., forty-four and three-tent
was 83 per cent. test, and represented, therefore, thirty-six
tenths pounds of 100 test sugar.

94.5 pounds	molasses..........	@ 26.6	= 25.2	lbs. 100 test
44.3 "	83 test sugar......		= 36.8	" " "
	Total.	.....	62.0	" " "

Under the conditions which governed this work, the
ton of unstripped and untopped cane yielded *sixty-two* pou
test sugar, of which *fifty-nine and three-tenths per cent.* c
and *forty and seven-tenths per cent.* remained in the molass

That this cane was practically of the same quality as th
the preceding trial may be seen from the following examin
sample of cane was milled after it had been stripped of its
sheaths and seed tops. The polariscope indicated 9.46 p
sugar in the mill juice, equivalent to *one hundred and twe*
per ton of unstripped and untopped cane, providing this
been harvested under ordinary conditions, for under ordin
tions each ton of such cane contains 75 per cent. of clean
which 85 per cent. is juice.

COMPARISON OF THE DIFFUSION RESULTS SECURED UNDE ABLE AND UNFAVORABLE CONDITIONS.

Conditions Unfavorable.

1. When sorghum is harvested while wet either with de
a single fanning is not sufficient to remove the leaves
sheaths.

2. Leaves and leaf sheaths interfere seriously with the concentration, color and purity of diffusion juices. The average purity of the feed for pan secured under such conditions was 57.6° only.

3. With such "feed for pan" the sugar boiler experienced great difficulty in securing grain.

4. The melada remained soft even after eight days' storage in the hot room.

5. The centrifugal machines sparated from this product 2.12 pounds of molasses for each pound of 83 test sugar.

6. This molasses was inferior in color and taste.

7. Of the total sucrose in the melada *fifty-nine and three-tenths per cent.* crystallized in the form of merchantable sugar, and *forty and seven-tenths per cent.* remained in the molasses.

8. This molasses contained practically no invert sugar.

Conditions Favorable.

1. When sorghum is harvested in fair weather, particularly after a light frost, a single fanning will remove most of the leaves and leaf sheaths. Double fanning, however, is advisable, even under these conditions.

2. The average purity of the pan feed from well cleaned cane was 69.1°.

3. With such feed for pan, care was necessary on the part of the sugar boiler to prevent sugar from crystallizing on the steam coils in the vacuum pan.

4. The melada, after forty-eight hours' storage, could scarcely be indented with the hands.

5. From this melada the centrifugal machines separated 1.33 pounds of molasses for each pound of 83 test sugar.

6. The color of this molasses was excellent.

7. Of the total sucrose in the melada *sixty-nine and seven-tenths per cent.* crystallized into merchantable sugar, and *thirty and three-tenths per cent.* remained uncrystallized in the molasses.

8. This molasses contained practically no invert sugar.

From the above summary it appears that *sixty-nine and seven-tenths per cent.* of the sugar in the melada crystallized under favorable conditions, and *fifty-nine and three-tenths per cent.* only crystallized under unfavorable conditions.

The following calculations will illustrate the signific figures:

During a season of sixty days the Rio Grande hou arranged to work *nine thousand tons* of unstripped and un

If this cane were similar to that worked during the p contained *one hundred and twenty* pounds of sugar pe *ninety* per cent. or one hundred and eight pounds of this s be secured in the melada. If the conditions under wh was worked were favorable, then *sixty-nine and seven-ten* of the *one hundred and eight* pounds, or seventy-five and pounds, should be found in the form of merchantable thirty per cent., or thirty-two and seven-tenths pounds, exist in ten and one-half gallons of molasses; seventy-fiv tenths pounds of 100 test are equivalent to ninety-four po test sugar; therefore, the nine thousand tons of cane sho

846,000 pounds of 80° test sugar.
94,500 gallons of 38° Baume molasses.

Under unfavorable conditions fifty-nine and three-tent of one hundred and eight pounds would crystallize. This sixty-four pounds of 100 test or eighty pounds of 80 tes ton. The molasses from each ton under such conditions contain forty and seven-tenths per cent. of one hundred pounds or forty-four pounds of 100 test sugar, equivalent gallons of 38° Baume. Nine thousand tons would, therefo

720,000 pounds of 80° test sugar.
126,000 gallons of 38° Baume molasses.

Leaves, therefore, which a single fan could not remove weather, would introduce into diffusion juices impurities prevent the crystallization of 126,000 pounds of sugar, thereby increase the yield of molasses by 31,500 gallons.

A fair cash market can readily be found for raw sugar. ages, too, in which such sugar can be shipped are relatively sive; for instance, sixty-three hogsheads, worth eighty-five would be sufficient for 126,000 pounds; the total outlay for in this case would thus be $53.50.

Large quantities of molasses cannot be readily sold. The for barrels, too, are relatively heavy; 31,500 gallons would require six hundred and thirty, worth one dollar each.

The shipment of molasses, therefore, costs nearly twelve times as much as the shipment of sugar.

The aim at Rio Grande, consequently, is to secure the largest possible amount of the available sugar in crystalline form, reducing the molasses yield to a minimum.

The above reasoning indicates that in this direction success within certain limits will depend upon the thoroughness with which the cane is stripped and topped.

III.

THE CHANGES AND IMPROVEMENTS NEEDED IN ORDER TO INCREASE RECEIPTS AND DIMINISH EXPENSES.

1. *Removal of the leaves and sheaths.*
2. *Shredding the cane.*
3. *Concentration of diffusion juices.*
4. *Bagasse.*
5. *Storage of cane.*

1.

REMOVAL OF THE LEAVES AND SHEATHS.

The results which were secured by diffusion under unfavorable conditions have been given in detail.

It is immaterial whether such a result is caused by rain, by dew, or by any other agent; if satisfactory returns are desired, provision must be made to strip and top cane under any condition which is liable to exist.

Experience has indicated that something may be gained by cutting the cane into two-inch instead of four-inch lengths, before elevating it to the fan. It has also taught that two fans are necessary, one placed above the other, each being provided with a properly constructed attachment for arranging the leaf and cane before subjecting them to the air blast.

All of these points have been carefully studied, and the necessary machinery can be constructed without involving serious expenditure.

SHREDDING THE CANE.

It has been shown on a previous page that thirty per c total sugar was lost in the bagasse and waste-water from th battery.

The cause of this loss lies in the size of the diffusion cl following experiment, made by Superintendent Hughes, cl trates.

Upon the 23d of October a large sample was drawn fr fusion bagasse and separated into three grades, viz., coars and fine.

A sample of each was milled and the juice polarized wi lowing result:

	Per cent of sugar.	Brix at 14° R.
Coarse	3.15	4.26
Medium	2.00	2.46
Fine, not pulped	0.96	1.46

Assuming that the bagasse weighed the same as the fresh contained eighty-seven per cent. of juice, then the followi tions can be made:

Coarse chips	100	:	87	: :	3.15	:
Medium chips	100	:	87	: :	2.00	:
Fine chips	100	:	87	: :	0.96	:

That is, two and eight-tenths per cent. of the coarse chip three-quarters per cent. of the medium, and eighty-four h per cent. of the fine, respectively, was sugar, and as this been found to contain 7.65 per cent. of total sucrose, it foll

$\frac{2.8}{7.65} = 36.6$ per cent. $\frac{1.74}{7.65} = 22.7$ per cent. $\frac{0.84}{7.65} = 11$

That the coarse chips in the bagasse still carried *thirty-si tenths* per cent., while the fine carried eleven per cent. o total sugar produced by the plant.

The sugar lost in the medium grade, viz., twenty-two a tenths per cent., corresponds closely with the average l mixed bagasse.

This is shown from the following trial: While the cane was being packed into diffusers, samples were drawn, dried, ground to a flour, extracted with alcohol and polarized after proper clarification. Calculated upon the stripped and topped basis, this cane was found to contain 7.65 per cent. of sugar. The bagasse from this cane was treated in a similar manner; upon the same basis, it was found to contain 1.93 per cent. of sugar. It follows, therefore, that, upon the average, this bagasse contained 25.2 per cent. of the total sugar produced in the fields.

The two knives used in chipping the cane were doubtless worked above their capacity, each cutting from forty to fifty tons daily. If four had been used instead of two, the cutting bars might have been adjusted so that the chips would have corresponded in size with those graded "fine" by Mr. Hughes, and an extraction of *ninety* per cent. thereby secured without decreasing the daily output of the works.

3.

CONCENTRATION OF DIFFUSION JUICE.

The comparison between milling and diffusion under ordinary conditions proved that, in concentration, mill juice from unstripped cane excelled diffusion juice from stripped cane. This result is radically different from the conclusions reached last season, when experiments upon a small scale proved that diffusion juice from stripped cane was more concentrated than mill juice from unstripped cane. The cause is believed to exist solely in the trouble experienced in properly filling the diffusion cells.

An attempt was made to pack them as silos are packed, viz., by treading the cane into all the corners and angles with the feet. The difficulties encountered were due chiefly to heat and impure air in the cells, it being clearly improper to ask men to work in such an atmosphere. One man was found, however, willing to make the attempt, and five cells were packed with the feet. The juice from these cells gave:

Sugar.	Brix.	Purity.
8.02 per cent.	12.81	62.6

Later in the day, when the ordinary method of working was practiced, the records show:

Sugar.	Brix.	Purity.
6.30 per cent.	10	63

This experiment indicates
methods of packing, and be
plished if the cells were tho
air-blast.

Improvement in the shape
necessary, however, before t
work can be done; for insta
under conditions which admit
gave the following:

Sugar.
9.63 per cent.

The average analysis of mil

Sugar.
8.93 per cent.

The diffusers, therefore, wo
the more concentrated product
exists for the dilute juices sec
tion of the battery and the ma
the sole cause of the increased

Plans have been already m
tion of the principle involved
allow of the complete control
concentrated product.

During the civil war consid
delphia, largely for the bagas
as paper stock. Since that ti
toward this product, particul
few years ago that pulp made
valued at 4½ cents per pound,

In 1883, the Rio Grande S
on this question, and learned
bagasse ranked next to that fr

A scarcity of water at the s
directions, and the heavy exp

introduced by the leaves prevented the erection of proposed pulping works.

The annoyance and expense caused by the present method of handling bagasse, as well as the absolute necessity of the strictest economy in all branches of the sugar business, again directs attention to this product.

The diffusion bagasse must now be free from leaf contaminations, and one of the greatest obstacles to financial success in pulping it has therefore been removed.

A recent analysis of this bagasse, made at this Station, gives results which, when calculated upon the basis of stripped and topped cane, indicates 5.5 per cent. of crude fiber.

It has been already stated that the Rio Grande Works can be equipped to handle nine thousand tons of unstripped and untopped cane in sixty days; the bagasse from this cane would therefore contain, approximately, *eight hundred thousand* pounds of crude fiber which could be worked into pulp, worth to-day at least three cents per pound. The expense and wastes incidental to this work are at present unknown, but the fact remains that thousands of dollars' worth of paper stock is now, at a very considerable expense, used to increase the size of compost heaps.

5.

STORAGE OF CANE.

Beets can be stored in cold weather for several weeks without noticeable depreciation in value to the sugar manufacturer. Sorghum, on the other hand, must be worked as soon as possible after it is harvested, for delays involve risk of serious losses.

Sorghum sugar manufacturers are therefore obliged to invest large amounts of capital in machinery in order to work rapidly. This machinery lies idle nearly ten months each year, and the difficulty of making the investment profitable is consequently very much increased.

It is evident that one of the most needed improvements at present is some method of preserving cane which will admit of its use in sugar manufacture during the winter, when good labor is both abundant and cheap.

One plan, recently proposed by Prof. Swenson, is to provide storage

silos in which cane, stripped, topped and shredded ready f
fusers, may be stored and used at the convenience of the su

Both plans seem reasonable and both should be carefully
all future experiments aimed at the development of this in

IV.

FINANCIAL CONSIDERATIONS.

Three years ago it was clearly seen that the Rio Grande
failed to secure one-half of the total amount of sugar pr
sorghum crops, and since that time all energies have be
toward the substitution of diffusion for milling. The c
this change, met at the very beginning, have at last been
and *seventy per cent.* of the sugar in the cane has this
extracted and sold. Information has also been gained wl
how *ninety per cent.* of the total sugar may be secured in

It still remains to be demonstrated that this industry c
a financial success.

In order to meet insurance, taxes, wear and tear upon
and interest upon the capital invested in the Rio Grande
an annual cash balance of nearly thirty thousand dollars m
in the treasury after all of the season's expenses have been
present market prices there is not enough sugar in the can
thousand acres of this plantation to admit of such a balan

The experience and experiments of this company hav
shown how another plantation and house of the same siz
equipped and managed with very much less capital, and
responding improvement in its chances of financial suc
Superintendent Hughes and the chemist of this Station
the sorghum sugar business can be made profitable, and cla
correctness of this opinion may be demonstrated by a hou
to work fifteen tons of cane daily.

Specifications for such a house have been already prepa
Hughes. The plans call for boilers, diffusers and evapor
ratus of *one-tenth* the capacity of the Rio Grande plant.
differences, however, appear in the relative proportion

indicates *one-fifth*, the shredding knife indicates *one-half*, and fans indicate *twice* the capacity of those used last season in working from 80–90 tons of cane daily. Cane elevators, which last season proved to be the chief source of delay and expense, have been abandoned, expensive pumps and pipe fittings have also been studiously excluded; in short, this house is planned to include only such machines and appliances as have been found profitable during the past five years. The amount of money, therefore, necessary to build and equip it will not exceed *five thousand dollars.*

Financial success involves also the study of field management. Questions of especial importance are, the varieties of sorghum, suitable fertilizers, the proper number of hills per acre, the period of growth at which the maximum amount of sugar *per acre* is available, the length of the season and the storage of cane for use during the winter. All of these questions can be properly studied in connection with a house of the proposed capacity without involving an area of more than eighty acres of land, or an additional expenditure of more than *six thousand* dollars. All of which should be recovered from the sales of sugar, seed and molasses, provided the crop ranks in quality with that of 1885 and meets the present *expectations* in regard to quantity, as the following calculations indicate:

120,000 pounds of raw sugar,	@ 4 cents =	$4,800 00
12,000 gallons of molasses...	@ 20 cents =	2,400 00
1,500 bushels of seed.........	@ 40 cents =	600 00
Total.................	....	$7,800 00

It is well known that the tendency in tropical cane countries is toward central stations, consequently it may seem strange that small houses should be advocated for the sorghum sugar industry; indications, however, point to this plan as the one best suited for its development and introduction.

The proper management of a farm involves the rotation of crops, and sorghum can be grown in the place of corn wherever it can be shown to be the more profitable plant.

Five thousand dollars can be secured in nearly every farming community, provided security and a fair rate of interest can be guaranteed; and half a dozen farms in one neighborhood could easily provide eighty acres of land upon which to raise the crop.

stable manure, &c., &c.

The following description is copied from the last annual report:

> "The field selected for this experiment is level, uniform in quality and protected from northeast storms by a heavy strip of woodland several hundred feet distant.
>
> "Its soil is a very sandy loam, easily worked and responsive to fertilizers. For several years in succession it has been cropped with sorghum, but has never been rated high in fertility.
>
> "Before arrangements were made for this trial the field had been dressed with a compost made of four tons of mill bagasse to one ton of yard manure. This had been spread uniformly at the rate of five tons per acre.
>
> "A tract five hundred and forty-eight feet long and one hundred and forty-five feet broad was accurately measured by a surveyor. Lanes four feet wide separated it, on either end, from the rest of the field; on one side it was bounded by a farm road and on the other by a fence. A headland, nearly eight feet wide, was left along this fence, principally to give the farmer who cultivated this field an ample opportunity to turn his horses without breaking down the young cane at this end of the rows; the farm lane answered a similar purpose at the other end.
>
> "This tract was first prepared as if intended for Indian corn. By means of lanes four feet wide it was then divided into sixteen plots, each one-tenth of an acre in area.
>
> "The fertilizers were sown broad-cast and harrowed in; the quantities and combinations used upon each plot, as well as the cost of the material, can be found in the following table. As in former experiments made by this Station, phosphoric acid was used in the form of bone-black superphosphate, and nitrogen in the form of nitrate of soda; muriate of potash was applied to some of the plots and sulphate of potash to others. Two tons of yard manure were spread upon plot 9, and forty pounds of land plaster upon plot 15. Two plots, Nos. 1 and 16, were left without fertilizers, in order to learn what the soil alone was able to produce."

Early Orange seed was planted in hills during the first week in May; these hills were three feet six inches apart, and each contained five stalks.

As was stated in the last annual report, plot 1 was located too near the site of a former compost-bed, as two or three of its outer rows clearly indicated. The records for this plot are, therefore, excluded, and all comparisons as to the effects of the fertilizers must be drawn against plot 16. By mistake, barn-yard manure was this year spread

Season of 1885. Seed Planted April 22d.
RIO GRANDE PLANTATION. EARLY ORANGE SORGHUM.
Weekly Record of Development, Expressed in Inches.

FERTILIZERS. KIND AND QUANTITY USED PER ACRE.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						Potash as Muriate.				Potash as High Grade Sulphate.						
		Nitrogen, 22.50 lbs. from Nitrate of Soda.	Phos. Acid, 52.50 lbs. from Bone Black Superphos.	Potash, 75.00 lbs. from Muriate of Potash.	Nitrogen, 22.50 lbs. Phos. Acid, 52.50 "	Nitrogen, 22.50 lbs. Potash, 75.00 "	Phos. Acid, 52.50 lbs. Potash, 75.00 "	Nitrogen, 22.50 lbs. Phos. Acid, 52.50 " Potash, 75.00 "	Barn-yard Manure, 20 Tons.	Potash, 80.00 lbs. from Sulphate of Potash.	Potash, 80.00 lbs. Phos. Acid, 52.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 " Phos. Acid, 52.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 " Phos. Acid, 105.00 "	Land Plaster, 400 lbs.	No Fertilizer.
		In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
June 2d	....	2.50	2.75	2.75	2.25	2.50	2.25	2.50	3.00	2.50	2 25	2.50	2.50	2.50	2.00	2.50
June 9th	....	3.50	3.50	4.50	3.50	3.50	3.25	3.50	4.00	4.00	4.00	3.75	4.00	4.00	3.50	3.25
June 16th	....	5.50	4.50	5.00	4.50	5.00	5.00	4.50	5.50	5.00	5.00	4.50	5.00	6.00	4.50	4.00
June 23d	....	11.00	9.00	10.00	9.00	12.00	10.00	10.00	12.00	9.00	9.00	10.00	11.00	13.00	8.00	8.00
June 30th	....	18.00	14.00	14.00	14.00	18.00	14.00	15.00	19.00	14.00	14.00	15.00	18.00	22.00	12.00	18.00
July 7th	....	29.00	28.00	23.00	24.00	27.00	25.00	26.00	30.00	28.00	27.00	26.00	28.00	31.00	21.00	21.00
July 14th	....	36.00	31.00	28.00	29.00	35.00	32.00	31.00	35.00	29.00	34.00	34.00	33.00	39.00	28.00	27.00
July 21st	....	52.00	44.00	41.00	37.00	46.00	37.00	44.00	50.00	37.00	44.00	44.00	48.00	51.00	32.00	34.00
July 28th	....	72.00	56.00	57.00	58.00	62.00	56.00	62.00	66.00	55.00	59.00	61.00	61.00	67.00	42.00	45.00
August 4th	....	80.00	67.00	70.00	68.00	78.00	66.00	75.00	79.00	68.00	69.00	75.00	76.00	80.00	53.00	55.00
August 11th	....	89.00	80.00	90.00	76.00	92.00	77.00	87.00	90.00	85.00	82.00	90.00	87.00	90.00	60 00	68.00
August 18th	....	108.60	96.00	108.00	86.00	104.00	91,00	97.00	100.00	100.00	96.00	100.00	100.00	107.00	67.00	76.00
August 25th	....	113.00	106.00	116.00	100.60	114.00	100.00	107.00	109.00	109.00	106 00	114,00	110.00	118.00	84.00	86.00
No. tons unstripped and untopped cane harvested per acre	....	19.11	17.17	19.59	18.83	22.19	19,91	19.96	17.53	16.82	16.89	17.08	17.18	16.21	9.81	10.17

Season of 1886. Seed Planted During First Week in May.
RIO GRANDE PLANTATION. EARLY ORANGE SORGHUM.
Weekly Record of Development, Expressed in Inches.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						Potash as Muriate.				Potash as High Grade Sulphate						

Plots Nos. 1, 2, 3, 5, 15 and 16, for the reason just given, are excluded from the comparison. A remarkable uniformity in development characterizes the remaining plots; slight variations occurred, of course, during the period under observation, but no one fertilizing element or combination of elements appears noticeably superior. At the date of the last measurement, August 25th, the range of variations was from 98 inches to 112 inches. The tallest cane, however, failed to yield crops proportionally heavy. For instance, the cane upon plot 9 was one foot taller than that upon plot 6, yet the latter plot gave the heavier yield per acre. Again, the cane upon plot 8, in comparison with that upon plot 4, excelled by seven inches, but the crop returns from each were practically identical in weight.

The comparison of the records of 1885 and 1886 indicates that a difference of two weeks in dates of planting exercised no marked influence. Upon the 9th of June, for instance, the measurements for both years are nearly the same. Excluding plots 2, 3, 5, 15 and 16, it will be noticed that upon the 28th of July the measurements for both years again agree in a remarkable manner, the only exception being plot 6. After this date, however, the development in 1886 became much slower, plots 8 and 9 only comparing favorably with their record for the previous year. Possibly a cause for this may be found in differences in temperature, but data relating to the degree of heat best suited for sorghum-development at this stage of its growth cannot at present be found. The Rio Grande record is as follows:

	1883.	1884.	1885.	1886.
Mean temperatures for month ending July 28th..................................	75.5°	76.8°	79.0°	75.9°
Mean temperatures for month ending August 25th...........................	76.8°	74.7°	77.2°	71.6°

The temperature during August, 1886, therefore, is noticeably lower than that for any previous year here recorded.

The Effects of Fertilizers Upon the Yields of Sugar Per Acre and Per Ton of Cane.

The methods followed last season, both in securing field-samples of the crop and in determining their percentages of sugar, were again used this year. They are as follows:

3.

What Element Exerted Most Marked Influence Upon Sugar Production.

In every case where potash was used a good stand of a fair quality of cane was secured. Wherever potash was not used cane relatively low in its percentage of sugar was grown, the "stand," too, in all cases being very poor. The conclusion is, therefore, that potash was the element which exerted most marked influence upon sugar production.

4.

What Effect Followed the Use of Phosphoric Acid.

By comparing plots 2, 3 and 4 it will be evident that phosphoric acid exerted a less favorable influence upon sugar production than either nitrogen or muriate of potash. When phosphoric acid was used in combination with nitrogen, plot 5, the yield of sugar fell below that from plot 2, upon which nitrogen alone was used; and when it was combined with both nitrogen and potash, it caused, in each case, a loss of more than three hundred pounds of sugar per acre. (Compare plots 8 and 13 with 6 and 12.) Further, when the amount of phosphoric acid was doubled, an additional loss of one hundred pounds of sugar occurred. (Compare 13 with 14.) With the exception of plot 7, phosphoric acid, in every case, positively decreased the yields of sugar per acre. These results are practically identical with those of last year and again corroborate the College Farm experiment made in 1883.

Phosphoric acid, however, must not be excluded from sugar plantations before its effects upon cane, early in the season, have been studied. It may be that its use would have been strongly advocated had this experiment been concluded in September instead of in November.

Is the Sulphate or the Muriate of Potash to be Preferred in the Cultivation of Sorghum.

Under the conditions which existed this year the crops from the muriate of potash plots excelled those from the sulphate plots, both in quantity and quality.

CONCLUSIONS.

1. Of all the fertilizing elements tested, potash, in the form of muriate, exerted the most favorable effect upon the yield of sugar per acre; its best results being secured when it was used in combination with nitrate of soda.

2. For two years in succession plot 6 has been fertilized with nitrate of soda and muriate of potash; plot 9, during the same time, has been dressed with stable manure, applied each year at the rate of twenty tons per acre. The crop, both of cane and sugar, from plot 6 has each year noticeably surpassed that from plot 9. During this period, at an expense of *fourteen dollars* for fertilizers, plot 6 has yielded sugar at the rate of 4,917 pounds per acre; during the same period, at an expense of *sixty dollars* for manure, plot 9 has yielded sugar at the rate of 3,632 pounds per acre.

II.

THE PROPER NUMBER OF HILLS PER ACRE.

At the close of the grinding season in 1885 it was evident that the sorghum sugar industry depended upon the diffusion process, but it was also evident that the cane leaves and sheaths must be removed before this process could be successfully introduced.

The machine for stripping cane, partially developed at that time, could do its best work upon large stalks, hence an attempt was made, by wide planting, to secure a crop containing as few small canes as possible.

In the experiment made in 1885 the cane rows were three feet apart, with hills at intervals of two feet. The hills, therefore, numbered 7,260 per acre; each contained five stalks. In the experiment made upon the same ground with the same kind of fertilizers in acre of cane may be steadily decreasing, involving thereby a loss in the absolute amount of sugar.

Such changes are probably occurring constantly, and farmers, whose entire work for sixty consecutive days consists in cutting and handling cane, have rough but suggestive methods for drawing comparisons. When loading green, juicy cane early in the season they compare it with lead pipes, later in the season the comparison is with dried corn-stalks. These variations escape a chemist who busies himself with the quality of the juice, for a ten-day average of analyses of juices at the beginning of the season may be almost identical with a similar average drawn at its close. If, however, the absolute quantity of juice per acre at the beginning and end of the season could be compared, striking results might be demonstrated.

Regarding these changes in the weight of the crop, the farm superintendent at Rio Grande, Mr. Wm. Hand, states that it was his custom early in the season to load ten slings full of cane upon each car for transportation to the sugar-house. This caused the trackmaster much work, and finally he reported his inability to keep his track in repair. Some of the overloaded cars weighed 6,000 pounds. Later in the season fourteen slings full of cane were piled upon each of the cars, which then failed to average more than 4,000 pounds. This means that a bundle of cane early in the season weighs six hundred pounds, and later in the season a bundle of the same size weighs only three hundred pounds. Incredible as this may seem these results are firmly believed to be, approximately, correct by men who are in position to make the most reliable observations.

This loss is not due solely to evaporation of water, for that would be followed by yields of sugar twice as large as normal cane affords, on the contrary, this loss in tonnage seems to be accompanied by a very marked decrease in the average yields of sugar per ton, as the following statements indicate:

During the period October 9th–October 23d, seven hundred and twenty-eight tons of unstripped and untopped sorghum was diffused, and an average yield per ton of *eighty pounds* of 100° test sugar thereby secured. Of this eighty pounds fifty-five and seven-tenths pounds crystallized and twenty-four and three-tenths pounds remained in the molasses. This cane was grown principally upon banked meadows, and although it may have passed its best sta sugar production, it was not considered "dried up" or p

On the 1st, 2d and 3d of November, two hundred a tons of unstripped and untopped cane was diffused, an yield per ton of *fifty pounds* of 100° test sugar thereb which thirty pounds crystallized and twenty pounds rei molasses. This cane was grown upon upland which had dressed with stable manure. Early in the fall it was first-class crop, and, as it was within easy reach of the su was held in reserve to be used in case any emergency ma to secure the necessary supply from more distant fields. T affords an unusual example of an over-ripe, pithy crop.

The green cane yielded eighty pounds and the pitl pounds of 100° test sugar per ton. If, therefore, this was accompanied by losses in tonnage as heavy as farmei milling wastes at once sink into comparative insignific one-half of the tonnage disappears, and if at the same ti tion of the crop which remains depreciates forty per cen the sugar boiler, it follows that *two-thirds* of the sugar f plant may be wasted by delays in field-work.

This reasoning rests upon claims and assumptions v easily and thoroughly investigated; it indicates that the ant question now awaiting solution is, "at what stage should sorghum be harvested."

FODDERS AND FEEDS.

In the report of this Station for 1886 it was claimed that from five to eight million dollars' worth of feed and fodder is consumed annually in this State by milch cows alone. The methods which should be followed in feeding live stock were then considered in detail and illustrated by numerous examples which demonstrated the following points:

1. That if waste products from flouring and oil mills are properly mixed with corn stalks and straw, economical substitutes for hay and grain will be secured for dairy purposes.

2. That the proportions in which such products should be mixed depends upon their chemical composition; and that the introduction of this system of stock-feeding into general use involves, therefore, the preparation of tables giving the average analyses of the different grades of all feeding-stuffs and fodders.

The first step towards the preparation of such tables for this State was taken last season, when one hundred and twenty samples of *feeds* were analyzed, tabulated and compared with the results of similar work in other States and countries. This work has been continued, and the following tables contain the analyses of eighty-one different samples of *fodders*, all of which have been secured this year; the counties from which they were drawn, the names of the inspectors and the dates of the inspection being given in each case.

Contrary to the general custom, the ash from each sample has also been examined and the amount of potash and phosphoric acid present in each kind of fodder thereby determined. Farmers who know the weights of their crops per acre can, therefore, calculate for themselves the amount of plant-food drawn from their soil each year, and a very little additional study will indicate how much of it goes back to the fields in the form of stable manure, and how much of it is permanently lost to the farm by the sales of milk, grain, hay, &c.

Following last y
been tabulated at t
tunity for comparii
by Professor Kühı
by Dr. Jenkins.

Questions relatii
been reserved for s
represent twenty-fi
reference a list is ta

Clover Hay....
Corn Stalks....
Timothy Hay
German Millet
Oats Straw......
Rye Straw......
Wheat Straw...
Lucern ....
Orchard Grass
Bag Hay........
Salt Hay........
Creek Sedge ..
Hungarian Gr
Hungarian Gr
Sweet Potatoe
Buckwheat St
Oil Meal.........
Timothy and (
Timothy, Red
Orchard Grass
Hay from Ban
Herd Grass....
Black Grass H
Short Sedge....
Marsh Rosema

Total ....

CLOVER HAY.

Station number.	Brand.	Pounds per hundred of: Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Percentage of: Nitrogen.	Phosphoric Acid.	Potash.
341	Clover Hay	6.11	2.38	29.71	7.40	13.00	41.40	2.08	0.41	3.02
344	" " 2d Crop	7.12	2.87	25.82	8.33	13.81	42.05	2.21	0.36	2.93
366	" "	7.88	1.88	27.28	6.59	13.56	42.81	2.17	0.50	1.15
367	" " White Clover	7.08	2.10	27.25	8.95	14.06	40.56	2.25	0.25	1.06
368	" " Alsike	7.46	1.64	29.52	6.44	11.44	43.50	1.83	0.39	2.15
379	" " 2d Crop	8.45	1.75	27.65	6.71	13.00	42.44	2.08	0.37	1.91
380	" " 1st "	8.30	1.80	28.68	6.77	13.50	41.00	2.16	0.32	2.06
390	" "	8.52	2.08	23.74	6.18	10.50	49.03	1.68	0.29	1.06
406	" "	8.50	2.38	24.60	6.42	13.50	44.60	2.16	0.31	1.24
415	" "	7.56	1.82	30.38	6.05	10.38	43.81	1.66	0.46	0.68
428	" "	7.62	2.20	35.65	4.95	10.31	39.27	1.65	0.25	1.20
	Average	**7.70**	**2.08**	**28.20**	**6.80**	**12.46**	**42.77**	**1.99**	**0.36**	**1.68**

TIMOTHY HAY.

Station number.	Brand.	Pounds per hundred of: Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Percentage of: Nitrogen.	Phosphoric Acid.	Potash.
353	Timothy Hay	8.67	1.62	30.30	4.20	9.19	46.02	1.47	0.31	0.90
357	" "	7.43	2.32	28.27	3.43	6.63	51.92	1.06	0.24	1.03
358	" "	6.47	1.98	24.55	3.77	6.50	56.73	1.04	0.35	0.81
361	" "	6.99	1.82	28.37	4.68	6.63	51.51	1.06	0.33	1.91
383	" "	7.43	1.83	29.25	4.85	6.19	50.45	0.99	0.25	1.32
394	" "	7.25	1.74	30.98	3.64	5.13	51.26	0.82	0.63	0.89
400	" "	7.50	1.77	27.68	4.98	7.31	50.86	1.17	0.33	1.71
414	" "	7.40	1.52	31.28	5.38	6.50	47.92	1.04	0.45	1.76
425	" "	6.12	1.78	27.71	3.56	3.75	57.08	0.60	0.38	0.91
431	" "	6.57	1.92	28.95	4.77	4.69	53.10	0.75	0.33	1.74
	Average	**7.18**	**1.83**	**28.73**	**4.32**	**6.25**	**51.69**	**1.00**	**0.36**	**1.30**

CLOVER HAY.

Station number.	Brand.	County.	Sa
341	Clover Hay, 1st Cut...........	Middlesex.........	Chemist o
344	" " 2d "	"	" '
366	" "	Burlington.........	H. I. Bud
367	" " White Clover...	"	" "
368	" " Alsike.............	"	" "
379	" " 2d Crop...........	Cumberland......	Theo. F. I
380	" " 1st "	"	" "
390	" "	Salem..............	Joseph L.
406	" "	Ocean...............	John H. I
415	" "	Gloucester.........	Geo. B. H
428	" "	Cape May..........	Ephraim

TIMOTHY HAY.

Station number.	Brand.	County.	Sa
356	Timothy Hay....................	Warren.............	Asst. Che
357	" "	Burlington.........	H. I. Bud
358	" "	"	" "
361	" "	"	" "
363	" "	Cumberland......	Theo. F. I
394	" "	Salem...............	Reeves F
400	" "	Ocean...............	John H. I
414	" "	Gloucester.........	Geo. B. H
425	" "	Cape May..........	Ephraim
431	" "	Middlesex.........	Chemist o

HAY FROM GERMAN MILLET, LUCERN AND ORCHARD GRASS.

Station number.	Brand.	Pounds per hundred of						Percentage of		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
348	German Millet	7.10	1.83	30.25	6.70	6.19	47.93	0.99	0.33	1.31
352	" "	9.05	1.70	27.85	5.03	12.25	44.62	1.96	0.32	0.94
381	" "	8.28	2.19	25.65	7.46	12.00	44.42	1.92	0.35	2.11
386	" "	8.14	1.68	28.58	6.72	7.06	52.82	1.13	0.37	0.99
388	" "	7.28	1.45	29.92	5.48	5.94	49.98	0.95	0.30	0.96
399	" "	7.65	1.90	27.81	6.11	5.00	51.58	0.80	0.51	1.27
430	" "	6.78	1.68	28.15	5.75	4.69	52.97	0.75	0.29	1.41
	Average................	**7.75**	**1.78**	**27.53**	**6.18**	**7.59**	**49.19**	**1.21**	**0.35**	**1.29**
338	Lucern, 1st Cut..............	7.55	2.40	26.22	8.61	18.56	36.66	2.97	0.43	2.60
342	" 2d "	5.66	1.80	33.04	6.49	17.56	35.45	2.81	0.42	1.98
347	" 3d "	6.25	1.96	31.38	6.19	15.00	39.22	2.40	0.34	1.72
	Average................	**6.48**	**2.05**	**30.31**	**7.10**	**17.04**	**37.11**	**2.73**	**0.40**	**2.10**
370	Orchard Grass................	6.88	1.36	36.47	3.93	3.63	47.73	0.58	0.23	1.14
387	" "	6.53	2.42	29.74	6.11	6.63	48.57	1.06	0.26	2.08
392	" "	7.32	1.67	30.70	5.48	6.88	47.95	1.10	0.36	1.70
	Average................	**6.91**	**1.82**	**32.30**	**5.17**	**5.71**	**48.08**	**0.91**	**0.28**	**1.64**

CORN STALKS.

Station number.	Brand.	Pounds per hundred of						Percentage of		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
349	Corn Stalks, Dent............	10.05	0.94	28.92	4.50	7.13	48.46	1.14	0.40	0.73
350	" " Yellow Flint	8.45	1.06	26.62	5.50	8.45	49.93	1.35	0.32	1.28
374	" Fodder....................	8.44	1.68	25.22	8.08	9.56	47.02	1.53	0.41	1.14
376	" " Sweet	8.68	1.95	24.08	11.00	7.75	46.54	1.24	0.16	1.23
382	" Stalks	7.86	1.10	28.73	4.40	5.00	52.91	0.80	0.10	0.43
395	" "	8.22	0.87	28.58	5.49	5.81	51.08	0.93	0.19	0.93
396	" "	8.33	0.90	28.80	5.36	5.38	51.18	0.86	0.23	1.47
411	" "	7.57	1.26	30.21	4.66	3.44	52.86	0.55	0.28	0.96
419	" " ....(?)	21.67	1.57	23.61	4.90	4.58	43.67	0 73	0.20	1.40
420	" " Western (?)......	9.39	1.18	27.08	4.80	4.26	53.39	0.68	0.18	0.94
427	" " Yellow Dent...	8.14	1.40	30.31	7.07	3.63	49.45	0.58	0 40	0.80
	Average................	**9.71**	**1.26**	**27.46**	**5.98**	**5.91**	**49.69**	**0.94**	**0.26**	**1.03**

HAY FROM GERMAN MILLET,
ORCHARD GRAS

Station number.	BRAND.	COUNTY.	S.
348	Hungarian Millet	Middlesex	Chemist
352	“ Grass Hay	Warren.	Asst. Ch
381	“ “ “	Cumberland	Theo. F.
386	German “ “	“	“ “
388	“ Millet	Salem	Omar B
399	“ “	Ocean	John H.
430	“ “	Cape May	Ephrai
338	Lucern, 1st Cut	Middlesex	Chemist
342	“ 2d “	“	“
347	“ 3d “	“	“
370	Orchard Grass Straw	Cumberland	H. I. Bu
387	“ “ Hay	Middlesex	Charles
392	“ “ “	Salem	Sheppar

CORN STALKS.

Station number.	BRAND.	COUNTY.	SA
349	Corn Stalks, Dent	Warren	Asst. Che
350	“ “ Yellow Flint	“	“
374	“ Fodder, Yellow Dent	Burlington	H. I. Bud
376	“ “ Sweet	“	“ “
382	“ Stalks	Cumberland	Theo. F.
395	“ “	Salem	Reeves F
396	“ “	Ocean	John H. I
411	“ “	Gloucester	Geo. B. H
419	“ “ Western	Middlesex	James Ne
420	“ “ Yellow Dent	“	“
427	“ “	Cape May	Ephraim

OATS STRAW.

Station number.	Brand.	Pounds per hundred of						Percentage of		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
351	Oats Straw	11.42	2.73	31.32	4.76	6.88	42.89	1.10	0.12	0.92
372	" " Barley	7.41	1.91	36.66	5.28	3.19	45.55	0.51	0.18	1.24
391	" "	7.95	1.80	40.28	4.65	3.19	42.18	0.51	0.23	1.36
408	" "	7.64	2.17	29.52	4.26	5.00	51.41	0.80	0.21	0.99
413	" "	7.64	2.28	38.44	5.05	3.88	42.71	0.62	0.49	1.86
424	" "	7.13	2.20	35.82	5.20	3.06	46.59	0.49	0.16	1.37
385	" "	7.26	1.72	41.80	4.06	3.06	42.10	0.49	0.12	0.80
	Average	**8.06**	**2.12**	**36.33**	**4.75**	**4.04**	**44.71**	**0.65**	**0.22**	**1.22**

WHEAT STRAW.

Station number.	Brand.	Pounds per hundred of						Percentage of		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
364	Wheat Straw	6.78	0.85	36.70	3.33	3.00	49.34	0.48	0.06	0.87
384	" "	6.84	0.81	37.62	4.12	3.19	47.42	0.51	0.10	0.75
403	" "	7.63	1.82	34.30	3.03	3.63	49.59	0.58	0.13	0.68
410	" "	7.07	1.58	34.51	3.34	2.94	50.56	0.47	0.05	0.67
	Average	**7.08**	**1.27**	**35.78**	**3.45**	**3.19**	**49.23**	**0.51**	**0.09**	**0.74**

RYE STRAW.

Station number.	Brand.	Pounds per hundred of						Percentage of		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
362	Rye Straw	6.30	1.29	41.52	3.60	2.75	44.54	0.44	0.33	0.84
363	" "	6.51	1.16	32.70	3.12	3.63	52.88	0.58	0.53	0.81
407	" "	7.15	1.15	38.32	3.31	3.19	46.88	0.51	0.37	0.51
409	" "	6.32	1.58	36.73	2.93	3.19	49.25	0.51	0.14	0.87
416	" "	6.80	1.15	39.46	3.14	2.88	46.57	0.46	0.21	1.06
417	" "	6.78	1.20	40.58	3.37	3.00	45.07	0.48	0.17	0.64
	Average	**6.64**	**1.25**	**38.22**	**3.25**	**3.11**	**47.53**	**0.50**	**0.29**	**0.79**

MISCELLANEOUS SAMPLES.

Station number.	BRAND.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
345	Hungarian Grass Seed......	9.51	4.72	7.65	4.96	9.94	63.22	1.59	0.47	0.36
346	" " Straw.....	10.98	0.90	32.18	6.38	2.75	46.81	0.44	0.11	0.98
348	Sweet Potatoes..................	67.90	0.36	0.60	0.82	1.28	29.04	0.20	0.04	0.33
354	Buckwheat Straw.............	9.00	0.65	37.16	6.51	7.75	38.93	1.24	0.13	1.14
355	Oil Meal, Old Process.......	7.63	9.40	7.21	5.18	38.19	32.39	6 11	1.89	0.64
356	Timothy and Clover Hay.	7.28	2.06	28.56	6.10	8.56	47.44	1.37	0.37	2.39
369	Red Clover, Alsike and Timothy....................	7.22	1.09	30.77	6.20	9.38	45.43	1.50	0.41	1.97
371	Orchard Grass and 2d Crop Clover................	7.76	2.65	24.12	5.62	14.00	45.85	2.24	0.58	1.20
393	Hay from B'nk'd Meadows	8.49	1.78	20.46	7.85	9.29	52.13	1.49	0.50	1.54
397	Herd Grass........................	7.48	1.50	26.62	4.80	6.25	53.35	1.00	0.35	1.57
423	Black Grass Hay...............	8.20	2.18	26.55	5.60	5.44	52.03	0.87	0.11	1.57
426	Short Sedge.......................	8.52	2.38	21.27	10.58	7.25	50.00	1.16	0.14	1.13
429	Marsh Rosemary...............	7.83	1.97	25.13	5.82	5.25	54.00	0.84	0.06	0.27

BOG HAY AND SALT HAY.

Station number.	BRAND.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
389	Bog Hay...........................	7.83	2.00	23.58	12 11	8.81	45.67	1.41	0 29	1.04
405	" "	8.33	2.29	26.66	4.54	6.51	51.67	1.04	0.07	0.42
	Average..................	**8.08**	**2.15**	**25.12**	**8.33**	**7.66**	**48.67**	**1.23**	**0.18**	**0.73**
378	Salt Hay...........................	8.16	2.11	25.08	7.14	5.13	52 38	0.82	0.10	0.92
422	" "	8.06	2.42	25.27	5.93	4.00	54.32	0.64	0.07	0.72
	Average..................	**8.11**	**2.26**	**25.18**	**6.53**	**4.57**	**53.35**	**0.73**	**0.09**	**0.82**

CREEK SEDGE.

Station number.	BRAND.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
418	Creek Sedge......................	49.01	0.62	14.41	5.44	1.20	29.32	0.22	trace.	0.37
421	" "	34.60	1.53	17.88	7.77	2.70	35.52	0.43	0.06	0.70
	Average..................	**41.80**	**1.08**	**16.15**	**6.60**	**1.95**	**32.42**	**0.33**	**0.03**	**0.53**

MISCELLANEOUS

Station number.	BRAND.	COUNTY.	
345	Hungarian Grass Seed.........	Middlesex.........	D
346	" " Straw.........	"	
348	Sweet Potatoes......................	Cape May.........	
354	Buckwheat Straw................	Warren..............	A
355	Oil Cake Meal........................	....	C
356	Timothy and Clover Hay....	Burlington..........	B
369	Red Clover, Alsike and Timothy........................	"	
371	Orchard Grass and 2d Crop Clover....................	"	
393	Banked Meadow Hay..........	Salem.................	O
397	Herd Grass............................	Ocean.................	J
423	Black Grass Hay....................	Cape May..........	E
426	Short Sedge..........................	" "	
429	Rosemary...............................	" "	

BOG HAY AND S

Station number.	BRAND.	COUNTY.	
389	Bog Hay................................	Salem.................	A
405	" " from Cranberry Bog	Ocean	J
378	Salt Hay, Middle Marsh......	Cumberland......	T
422	" " " "	Cape May..........	E

CREEK SE

Station number.	BRAND.	COUNTY.	
418	Creek Sedge..............................	Cape May..........	M
421	" "	" "	E

BRAND.	FROM THE REPORT OF	Number of Analyses.	DRY MATTER.			PROTEINE.			FAT.			NITROGEN, FREE EXTRACT.			CRUDE FIBER.			ASH.
			Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	
Clover Hay.	Professor Julius Kuhn...............	......	77.10	90.00	83.30	7.20	15.80	11.00	1.20	5.50	3.20	22.80	39.70	32.90	19.50	43.00	29.90	6.30
	Dr. E. H. Jenkins, Conn. Station.	12	78.18	91.53	84.98	8.87	18.06	11.38	1.47	3.10	1.98	35.08	45.47	40.11	23.79	28.64	26.35	5.15
	New Jersey Station......................	11	91.48	93.89	92.30	10.31	14.06	12.46	1.64	2.87	2.08	39.27	49.03	42.77	23.74	35.65	28.20	6.80
Timothy Hay...	Professor Julius Kuhn...............	......	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Dr. E. H. Jenkins, Conn. Station.	18	85.70	91.30	87.42	4.88	9.60	6.86	1.08	3.30	2.08	41.09	48.58	44.89	22.70	34.25	29.98	4.23
	New Jersey Station......................	10	91.33	93.88	92.88	3.75	9.19	6.25	1.52	2.32	1.83	46.02	57.09	51.69	24.55	31.28	28.73	4.32
Lucern	Professor Julius Kuhn...............	......	80.30	87.50	83.80	13.1	19.7	14.40	2.30	3.80	2.50	20.00	34.80	27.90	19.30	40.00	33.00	6.00
	Dr. E. H. Jenkins, Conn. Station.	......	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	New Jersey Station......................	3	92.45	94.34	93.52	15.00	18.56	17.04	1.80	2.40	2.05	35.45	39.22	37.11	26.22	33.04	30.34	7.10
Millet...............	Professor Julius Kuhn...............	......	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Dr. E. H. Jenkins, Conn. Station.	8	....	....	83.30	5.56	10.67	6.59	1.30	2.14	1.81	34.85	44.71	42.49	26.18	28.94	27.16	5.24
	New Jersey Station......................	7	90.95	93.22	92.25	5.00	12.25	7.59	1.45	2.19	1.78	44.42	52.97	49.19	23.58	30.25	27.53	6.18
Salt Marsh Hay	Professor Julius Kuhn...............	......	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Dr. E. H. Jenkins, Conn. Station.	11	81.40	93.80	89.58	4.30	7.80	5.90	1.68	3.10	2.32	34.10	53.67	42.42	27.00	37.90	31.47	7.42
	New Jersey Station......................	2	91.84	91.94	91.89	4.00	5.18	4.57	2.11	2.42	2.26	52.88	54.82	53.85	25.08	25.27	25.18	6.53

Brand.	From the Report of	Number of Analyses.	Dry Matter.			Proteine.			Fat.			Nitrogen, Free Extract.			Crude Fiber.			Ash.
			Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Average.
Corn Stalks......	Professor Julius Kuhn..................	......	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Dr. E. H. Jenkins, Conn. Station.	6	60.63	77.07	67.95	3.89	4.97	4.29	0.66	1.56	1.24	30.52	40.82	35.96	18.65	25.18	22.14	4.32
	New Jersey Station....................	11	78.83	92.48	90.29	3.63	9.56	5.91	0.87	1.95	1.26	48.67	57.47	49.69	23.61	30.31	27.46	5.98
Wheat Straw....	Professor Julius Kuhn..................	......	74.00	91.90	85.70	1.40	5.60	3.10	0.60	2.00	1.20	26.70	44.40	37.50	28.90	52.60	40.00	3.90
	Dr. E. H. Jenkins, Conn. Station.	2	88.63	92.22	90.43	2.19	2.56	2.37	1.24	2.53	1.89	41.51	47.01	44.27	37.32	40.05	38.68	3.22
	New Jersey Station......................	4	92.87	93.16	92.92	2.94	3.63	3.19	0.81	1.82	1.27	47.42	50.56	49.28	34.30	37.62	35.78	3.45
Rye Straw........	Professor Julius Kuhn..................	.....	81.40	89.70	85.70	1.50	4.60	3.00	1.10	2.50	1.80	28.40	44.50	33.80	30.10	54.90	44.00	4.10
	Dr. E. H. Jenkins, Conn. Station.	1	....	....	87.50	....	....	6.89	....	....	2.68	....	....	35.70	....	....	34.20	3.08
	New Jersey Station......................	6	92.85	93.70	93.36	2.75	3.63	3.11	1.15	1.58	1.25	44.54	52.88	47.53	32.70	41.52	38.22	3.25
Oats Straw.......	Professor Julius Kuhn..	......	78.80	89.70	85.70	1.80	7.00	4.00	1.00	5.10	2.00	24.90	48.90	35.60	30.00	50.20	39.70	4.40
	Dr. E. H. Jenkins, Conn. Station.	3	87.50	93.47	89.89	2.30	5.08	3.85	1.00	3.15	2.07	26.42	44.26	36.97	35.21	55.96	42.78	4.72
	New Jersey Station......................	7	88.58	92.87	91.94	3.06	6.88	4.04	1.72	2.78	2.12	42.10	51.41	44.71	29.52	41.30	36.33	4.75
Buckwheat Straw.	Professor Julius Kuhn..................	......	84.50	90.80	87.90	3.10	5.50	4.10	1.30	1.60	1.40	29.90	37.10	32.90	35.80	51.80	44.80	5.28
	Dr. E. H. Jenkins, Conn. Station.	2	89.50	89.60	89.55	3.33	4.38	3.85	1.42	1.70	1.56	32.08	34.49	33.28	44.93	46.83	45.88	5.05
	New Jersey Station......................	1	....	....	89.02	....	....	7.75	....	....	0.65	....	....	38.93	....	....	37.16	6.51

LUCERN, OR ALFALFA.

(*Medicago sativa.*)

Its advantages and disadvantages.
Letters relating to its growth in New Jersey, from Mr. G. W. Thompson and Dr. A. D. Newell.
Comparison between alfalfa and clover.
The period of growth at which alfalfa should be cut.

When large herds of milch cows are kept upon small farms and soiling is the farmer's chief reliance, great need is often felt of some green crop to use after fodder rye has become unfit for stock food. This sometimes occurs two or three weeks before clover is in condition to be used with profit.

Of all crops hitherto grown in this State, lucern, sometimes known as alfalfa, is one of the earliest to mature, and consequently promises most in this respect; it offers, in addition, advantages which few other plants possess; briefly, some of these are as follows:

Lucern when once well rooted withstands drought and frost in a remarkable manner.

In New Jersey it can be cut three or four times each season, for five or six years in succession, yielding, under favorable conditions, as heavy a tonnage per acre as fodder corn, which it noticeably surpasses in quality.

Testimony drawn from reliable sources in England, in the United States, and in South America, indicates that, when cut while in blossom and fed green, it is greedily eaten by working horses, and is found to be excellent food for them. Its value as hay is also very high.

It resembles clover in its preparation of the ground for following crops, for after a field has supported lucern for seven consecutive years it can then produce more grain than before.

As experiments with it were made by Chancellor Livingston in New York State ninety years ago, with very flattering results, and as agricultural journals and reports for many years past contain numerous well-written and very favorable descriptions of the plant, and further, as it is now recognized as the main dependence in many Western States, it is difficult to understand why it has not come into general use, particularly in certain sections of New Jersey which are noted for light soils with relatively open subsoils, and a water-level

perhaps eight feet from the surface of
for this neglect differ with localities, o
the difficulty of securing a good "ca
deep plowing, thorough harrowing, an
broadcast. Weeds and grasses quickl
alfalfa; this renders cultivation desira
a necessity. The advantages which fol
are put in a strong light by Jethro Tu
"The Horse Hoeing Husbandry," pub
is well known, however, that conditi
which make drilling and cultivation
not refer to harrowing in the spring,
regard as the first step to be taken i
field. The selection of seed from re
necessary; carelessness in this respect
of many failures.

That lucern is now successfully gr
strated by the following extract fron
Mr. George W. Thompson, of Stelt
Director of this Station:

"From my three years' experience v
crop, I am very sanguine as to its va
any good ration for beef or butter;
interposes her say that, 'last summer
had been feeding alfalfa the day befor
its analysis, rating higher in albumino
forage plants.

"For soiling with intensive farmin
be made a decided success. It may be
clover is usually ready, and when gree
usually relished by cattle. The secon
make a good and easily-cured hay, w
much better than the usual second-cro
stances.

"This is my faith now about the
plant an additional acre, at least, the c

"The soil is a light, not sandy, loam
shall apply fifteen loads, on a Kemp
straw and cornstalks) to the acre, plo
ground, so as to get it in a good state o

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[*] Jethro Tull was born in 1680 and died in 1740; his t
reference was taken from Corbett's edition, published

face, two or three hundred pounds of acid phosphate, with about as much muriate of potash, or its equivalent in kainit, relying on my stable manure for all the nitrogen I want. I will sow after the middle of April, as soon as the ground will suit. I expect, with an ordinary season, to cut two good crops from the seed sown this spring.

"From my present experience, twenty pounds of seed is not enough to produce a maximum crop.

"I am not so sure that, for ordinary farm use, it will take the place of clover in this part of New Jersey. The first crop matures before we have good haying weather, generally, but for soiling or silage, I am of opinion we have in lucern a better and cheaper crop than corn fodder. I have not been successful in raising seed."

A letter from Dr. A. D. Newell, of New Brunswick, also contains matter of interest.

"NEW BRUNSWICK, Mar. 3d, '87.

"*Prof. Geo. H. Cook:*

"DEAR SIR—A few years ago I sowed four acres of alfalfa. It came up in twelve days and grew rapidly. I think I sowed it after oats and cut it once that season. There was a drouth for some time after seeding, and the catch was not even, so I plowed it in, after cutting it three times the second season. I found the roots long and branching.

"Mr. Joseph Corbit, just back of the Hoffman farm, has an acre or so on shale; has cut it three times a season for the last two seasons. He feeds it green, and the cattle do well on it. He is very much pleased with it, and intends to sow more this season. It does not heave out like clover, as the roots take such firm hold.

"Respectfully yours,

"A. D. NEWELL."

Mr. Thompson allowed the chemists of this Station to stake off a square rod in his alfalfa field, and also afforded them every opportunity for cutting, weighing and sampling the first, second and third crops from this area. He also fixed the dates upon which to cut the crop, in order to secure the most favorable results, paying due regard both to the quantity and quality of the product.

For the sake of comparison with lucern, a square rod of unusually fine clover was staked off upon the farm of Professor Geo. H. Cook, near New Brunswick. The first and second crops were cut from this plot in each case, when this clover was at its best, in the opinion of practical farmers.

The chemical analysis of samples of both products, secured from the above cuttings, gave the following results:

Station number.	BRAND.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
338	Lucern, 1st Cut, June 4th, '86..	79.43	0.54	5.84	1.92	4.13	8.14	0.66	0.10	0.58
342	" 2d " July 19th, '86..	73.80	0.49	9.08	1.78	4.82	10.03	0.77	0.12	0.54
347	" 3d " Sep. 11th, '86..	70.00	0.63	10.02	1.98	4.79	12.58	0.77	0.11	0.55
	Average......................	**74.41**	**0.55**	**8.31**	**1.89**	**4.58**	**10.25**	**0.73**	**0.11**	**0.56**
341	Clover, 1st Cut, July 30th, '86..	73.48	0.67	8.38	2.08	3.66	11.73	0.59	0.12	0.85
344	" 2d " Aug. 26th, '86..	68.89	0.96	8.66	2.79	4.63	14.07	0.74	0.12	0.98
	Average......................	**71.19**	**0.81**	**8.52**	**2.43**	**4.15**	**12.90**	**0.67**	**0.12**	**0.92**

This table indicates no very noticeable differences, in chemical composition, between clover and lucern. A second table is needed to show their relative yields of food per acre:

LUCERN.	Tons per Acre.	CONTAINING POUNDS PER ACRE OF				
		Fat.	Fiber.	Ash.	Proteine.	Carbohydrates.
First Cut, June 4th....................................	8.25	89.0	978.4	316.4	680.6	1,341.5
Second Cut, July 19th...............................	6.16	60.4	1,118.7	219.3	593.8	1,235.7
Third Cut, Sept. 11th................................	3.76	47.4	753.5	148.9	360.2	946.0
Total..	18.17	196.8	2,850.6	684.6	1,634.6	3,523.2
CLOVER.						
First Cut, July 30th, '86............................	10.88	152.3	1,823.5	452.6	796.4	2,552.4
Second Cut, Aug. 26th, '86.......................	4.16	79.9	720.5	232.1	385.2	1,170.6
Total..	15.04	232.2	2,544.0	684.7	1,181.6	3,723.0

Three cuttings of lucern yielded 18.2 tons, and two cuttings of clover yielded 15 tons per acre of green fodder, which was weighed, in each case, before any loss of moisture had occurred.

The production per acre, by each crop of carbohydrates, including fiber, was practically identical, the difference, amounting to less than two per cent., being in favor of the lucern.

The clover excelled by seventeen per cent. in the production of crude fat, but the lucern excelled by nearly forty per cent. in the production of crude proteine.

In their demands upon the soil, these crops were absolutely identical as regards quantity, for each contained 685 pounds of ash per acre. The following table will give an idea of the chemical composition of this ash, and, at the same time, indicate the requirements of these plants.

The Quantities of Nitrogen, Phosphoric Acid, and Potash per Acre, Removed Annually by Lucern and Clover.

BRAND.	Pounds of Nitrogen.	Pounds of Phosphoric Acid.	Pounds of Potash.
Lucern, 1st Crop	108.8	16.5	95.6
" 2d "	94.9	14.8	66.5
" 3d "	57.9	8.8	41.4
Total	**261.6**	**39.6**	**203.5**
Clover, 1st Crop	128.4	26.1	185.0
" 2d "	61.6	10.0	81.5
Total	**190.0**	**36.1**	**266.5**
20 tons of excellent Yard Manure	204.0	164.0	200.0

In their demands for phosphoric acid, clover and lucern agree very closely, but lucern, apparently, can develop its crop with approximately 25 per cent. less potash than clover utilizes.

The demands for plant-food seem enormous, however, in both cases, and may be expressed as follows: The plant-food in the crop from one acre of Mr. Thompson's alfalfa represents the following weights and values of fertilizers:

The first nine inches of the poorest soil contains enough potash to support alfalfa for ten years, and enough phosphoric acid to support it twenty years. In these respects the best soil would support the crop four times as long. Nitrogen appears to be deficient in one case and abundant in the other.

The following statement from the Report of the Commissioner of Agriculture for 1873 indicates, however, that alfalfa, in securing its food, is not limited to surface soils:

> "The freshet of last winter cut away the bank of a creek, exposing a section of an alfalfa field. The roots of the plant had penetrated to a depth of from 12 to 20 feet, and were exposed, by the washing away of the bank, from the surface to the water-line. The diameter of the root at the crown, on the surface, varies from an eighth to half an inch. They taper gradually to the lower end, from which a cluster of roots or feeders put out. In the section exposed, the roots were close together, but entirely disconnected, each one growing straight through the soil to the water, and producing on the surface a luxuriant branch of alfalfa, which keeps green the year round."

If the alfalfa is fed to live stock upon the farm, it must be regarded as an extremely valuable agent for bringing into circulation the capital invested in the subsoil. If it is raised for market, however, it should be remembered that a crop as heavy as Mr. Thompson's contains plant-food which would cost, in the shape of fertilizers, more than fifty dollars per acre, a fact which should be distinctly seen both in the purchase and sale of this product.

At what Period in its Growth should Lucern be Cut in Order to Yield the Largest Amounts of Food per Acre.

This question was carefully studied, in 1873, by the German investigator, Dr. Paul Wagner.

Two plots, each containing two square rods, were staked off in an alfalfa field. The crop from one was cut three times, each time just before the blossoms appeared. That from the other plot was cut twice only, after most of the plants were in full bloom.

The results can be seen from the following table:

PLOTS.	Tons per Acre.
Plot A. 1st Cut, May 31st	9.4
2d " June 8th	5.5
3d " September 1st	2.4
Total	17.3
Plot B. 1st Cut, June 30th	11.6
2d " August 20th	10.5
Total	22.1

Two crops cut while the plants w
than three crops taken each before t

It is noticeable, however, that whi
in its yield of fat by twenty-one pe
teen per cent., its principal gain w
drates and crude fiber, the former
latter by seventy-three per cent.
large quantity of fiber in the older
bility is not materially reduced th
like clover, should be cut almost im
appeared.

◆

HUNGARIAN GRASS, O

(Panicum Ge

Hungarian grass or German mil
about which a great deal has been
years. Its value depends largely u
sown early in June, after a correct c
the coming clover crop. Approxim
will be fit either for soiling or hay n
fore, for clearing the land and prep
nary conditions satisfactory yields
when the grass is properly treated ve
it, although under certain conditions

The most serious criticism against it is that it exhausts the ground. Several progressive farmers are known who have tried the plant and have been pleased with its products, but they decline to try it again because of its injurious effects upon following crops. This criticism is, however, by no means universal, as the following abstract from a letter recently received from Mr. Adrian Vermeule, New Brunswick, Middlesex county, will indicate:

> "This millet, when cut at the proper time, makes excellent hay for cattle, better than timothy and very nearly equal to clover mixed. It yields well, and for a crop preceding wheat, I think, leaves the land in better condition than oats. The past season I left two and one-half acres for seed. The yield was twenty bushels per acre; when left for the seed to ripen the hay is woody, and, in my opinion, not superior to oat straw. After harvesting the millet, the field was manured, limed and fertilized alike throughout, and sowed with wheat. Where the millet had been cut for hay the wheat looks better than it does where it was left for seed."

In 1886 Mr. Vermeule substituted millet for oats on seven acres of his farm. He allowed the Station's chemist to measure off a definite area in this field, from which the crop was cut and weighed on the second of August; the seeds then were formed but were still very soft; all samples necessary for a chemical examination of the hay were also secured on this date. One month later a measured area was also staked off from a portion of one field which had been reserved for seed. The crop from this plot was dried, threshed in due season, and the weights of its products accurately determined. The returns indicated thirty-three bushels of seed and two tons of straw per acre. Both seed and straw have been analyzed; the results are published in the preceding table on fodders, indicated by Station numbers 345 and 346.

The leading object of this work on millet was to secure information relative to its exhaustion of the soil.

The plan was to compare it with mixed clover and timothy in order to learn—

I. The relative amount of animal food produced by each crop.

II. The amounts of plant-food extracted by each from the ground.

The sample of mixed clover and timothy was taken from an experimental plot on the College Farm, upon which barn-yard manure had been used for three consecutive years, each year at the rate of twenty tons per acre.

The experimental plot of millet on Mr. Vermeule's farm was located upon the edge of a former compost heap, and was characterized by an unusually heavy and rank growth.

I.

THE RELATIVE AMOUNTS OF ANIMAL FOOD PRODUCED IN CROPS OF MIXED HAY AND GERMAN MILLET.

The percentage composition of each product can be seen from the following table:

Station number.	BRAND.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
343	Hay from Hungarian Grass........	7.10	1.83	30.25	6.70	6.19	47.93	0.99	0.33	1.31
431	Mixed Clover and Timothy Hay..................................	6.57	1.92	28.95	4.77	4.69	53.10	0.75	0.33	1.74

As a rule, these analyses indicate slight differences only in the quality of these fodders; one of the most valuable ingredients, the proteine, forms, however, a striking exception. This becomes, of course, more marked when the calculations are expressed as pound of animal food per ton of hay.

BRAND.	ONE TON OF HAY CONTAINS FOLLOWING WEIGHTS OF ANIMAL FOOD.				
	Fat.	Fiber.	Ash.	Proteine.	Carbohydrates.
	lbs.	lbs.	lbs.	lbs.	lbs.
Hay from Hungarian Grass..	36.6	605.0	134.0	123.8	958.6
Mixed Clover and Timothy Hay................................	38.4	579.0	95.4	93.8	1,062.0

In carbhydrates the mixed hay excels by more than *ten* per cent.; in proteine, however, the millet excels by *thirty-three per cent.* These calculations are of especial importance to those who purchase and sell hay by the ton. Farmers, however, must be governed by the relative yields per acre, at least, until the feeding value of a crop has a more positive influence upon its market price.

BRAND.	Tons per Acre.	CONTAINING POUNDS PER ACRE OF				
		Fat.	Fiber.	Ash.	Proteine.	Carbohydrates.
Hay from Hungarian Grass	2.6	95.2	1,573.0	318.4	321.9	2,492.4
Mixed Clover and Timothy Hay	3.6	133.2	2,084.4	343.4	337.7	3,823.2

The farms upon which these crops were grown are approximately two miles apart, both are credited with red shale soils and both have been farmed in the same general manner. Each farmer regarded his crop as thoroughly satisfactory, and probably three and six-tenths tons of mixed hay and two and six-tenths tons of dried millet per acre may be regarded as representative yields of each. On this assumption, an acre in mixed hay yields as much proteine as one in millet, but in carbhydrates and fiber, the mixed hay excels by more than forty-five per cent.

Regarded from the producers' standpoint, the mixed clover and timothy is the more profitable crop, and Hungarian grass must be regarded as a supplementary plant which may be sown after it is evident that a poor catch or severe winter has made an average hay yield impossible.

II.

THE AMOUNTS OF PLANT–FOOD EXTRACTED FROM THE SOIL BY CROPS OF MIXED HAY AND GERMAN MILLET.

The analysis printed upon a preceding page gives the percentages of nitrogen, phosphoric acid and potash, both in mixed hay and dried millet. These have been recalculated into absolute weights per ton of hay with the following results. For comparison, the number of pounds of each of these three elements of plant-food to be found in a ton of clover or lucern has also been added:

Hay from Hungarian Grass...
Timothy Hay and Clover......
Clover, Average of Two Cuts
Lucern, " " Three "

With a single exc
than either of the
exception is found in

When these result
the results are still
table shows:

Hay from Hungarian Grass....
Timothy Hay and Clover.......
Clover " ....
Lucern ....

A crop of mixed cl
more nitrogen, more
cent. than a crop of n

A crop of clover ex
and twice as much ph

Lucern, in some res

A more definite opi
food removed from

gained by computing the cost of returning to the soil equivalent amounts of equally available plant-food, used in the form of commercial fertilizers.

The estimates are as follows:

BRAND.	NITRATE OF SODA.		ACID PHOSPHATE.		MURIATE OF POTASH.		
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
Hungarian Grass and Hay................	320	$8 00	130	$0 98	175	$3 50	$12 48
Timothy Hay and Clover..................	335	8 38	180	1 35	250	5 00	14 73
Clover Hay..	1,190	29 75	300	2 25	530	10 60	42 60
Lucern "	1,625	40 63	300	2 25	410	8 20	51 08

The lightest demands are made by Hungarian grass, for the cost of returning all of the expensive food removed by it from an acre of soil is $12.48 only; still the Hungarian grass is considered an exhaustive crop. The heaviest demands are made by clover and lucern. A good clover crop, for instance, takes $42.60 worth of expensive plant-food from an acre, and $51 is needed to replace that extracted by an acre of lucern, yet both of these crops leave the surface-soil noticeably enriched by their growth.

The question, therefore, depends upon the location in the ground from which each crop extracts its food.

Clover and lucern are well-known deep feeders; timothy roots have also been followed two or three feet below the surface, but millet, on the other hand, is said to feed entirely in the first three or four inches of soil. Admitting the truth of these statements, and the differences between these crops consists solely in the fact that one class drains the subsoil, and its effects are noticed only after years of cultivation; the millet drains the surface-soil and its effects are at once apparent.

All are valuable servants to the farmer when their habits of growth are understood.

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Dennis Callaghan, of Freehold, has 1,200 trees, 4 to 5 years old, on light, sandy soil with sand subsoil. He has used Mapes' fruit and vine manure one season with good effect, obtaining some good fruit. His trees do not look well, and many are dying out.

George H. Schank, of Freehold, has 1,000 trees, 9 to 10 years old, on land which had been lately cleared, the soil being a sandy loam with gravel bottom and a rolling surface. He fertilizes mostly with lime and marl. His cultivation is good and his trees are looking healthy, but very much more vigorous upon a portion of the ground which has formerly been used in growing sweet potatoes.

E. B. Hender, of Vineland, has 800 trees, 13 years old, on gently sloping ground, with a sandy, gravelly soil with clay subsoil. This ground had been in cultivation but a few years before the orchard was planted, and formerly was occupied by a growth of pine and oak wood, and was cropped after clearing for a few years with corn and potatoes. For 2 years the orchard was occupied with hard crops, and afterwards has had thorough cultivation, the cultivation being commenced early in spring and continued through the season. The trees are kept free from borers, are treated with potash and bone, and give paying crops of fruit and are looking well.

J. C. Wheeler, of South Vineland, has 500 trees, 5 years old, and 300, 8 years old, on sandy soil with clay subsoil and rolling surface. He keeps the trees free from borers, cultivates well through the season till picking time, fertilizes with equal parts of kainit, muriate of potash, bone and sulphate of soda, and acid rock, with good results, and his trees are looking well.

E. F. Sharp, of Bridgeton, has been growing peaches successfully for 25 years, and has now 800 bearing trees, 6 years old, on a sandy, gravelly loam with clay subsoil and rolling surface. He plants his trees upon clover sod or on ground which has been in corn 1 season, and crops the orchard 2 years with corn, using stable manure for a fertilizer. After the first year he uses 200 pounds bone and 200 pounds muriate of potash per acre, giving thorough cultivation and keeping free from borers. He has sold from these 800 trees, since coming into bearing, 4,200 baskets of fruit, for $2,184 net, 2,100 baskets of which were sold in 1885, at 57 cents per basket. The trees are now looking well.

Robert Ware, of Bridgeton, has 1,000 bearing trees, 4 years old, on clay loam with clay subsoil and rolling surface. From these, in

1886, he sold 1,200 baskets of fruit, at a
per basket. He practices clean cultivatio
He has just taken out 1,000 trees, 10 ye
received 6 crops of good fruit. He plan
first year and melons the second, fertilizin
wards using kainit, ashes and bone.

Isaac M. Smalley, of Roadstown, has
years old, on sandy loam with clay subsoil
sets his trees on corn ground, and crops
for the first 2 years, practicing clean c
borers whenever they appear. He fertil
using 300 pounds of each per acre, applie
no yellows. In 1873 he sold from 4 ac
for $1,800 dollars. In 1882 he sold fron
fruit, for $3,650, and in 1884, sold 1,200
trees, for $672. In 1876 he took out an
paying crops till 21 years old. He has
for 5 years, with satisfactory results.

Charles Bidders, of Greenwich, has 840
loam with clay bottom, from which he re
the past season. On this orchard he is
kainit, 300 pounds bone and 200 pound
He plants his trees on corn ground and cu
2 years, fertilizing the corn with stable m
out an orchard of 1,400 trees, 11 to 14
from overbearing. At 3 years old, he use
from it 900 baskets of fruit; at 4 years o
$2,100; at 5 years old, used kainit an
$1,600; at 6 years old had only a light
kainit and sold 1,500 baskets for $75
baskets for $600; at 9 years old, light
500 baskets.

Charles Miller, of Greenwich, has 1,100
loam with clay bottom and sloping surface.
kainit at the rate of 500 pounds to 700 po
of 300 pounds to 500 pounds per acre, bu
trees are large, seems to be declining. F
sold $1,300 worth of fruit; in 1885,
There are upon his farm 50 trees 20 yea

crop the past season. I could learn but little of the former treatment of these old trees, as the present occupant of the farm has been there but 3 years.

T. E. Hunt, of Greenwich, has 1,100 trees, 6 years old, on clay loam with clay subsoil and rolling surface. Corn planted on clover sod occupied the ground the season before the trees were put out. Mr. Hunt considers it of great importance to set out perfectly healthy trees, and also to keep the orchard well cultivated and clear of borers. He cultivates till into July, plowing only once and then doing the work with a wheel or Acme harrow. He fertilizes with muriate of potash and bone, using 200 pounds of potash and 300 pounds of bone to the acre. Since this orchard has been planted it has produced three crops, which have been sold for $4,008.05 net, the last crop, in 1886, realizing $2,080.54. This orchard occupies about 10 acres of land, and the majority of the trees are looking well. Mr. Hunt is now taking out an orchard of 200 to 300 trees, which are 20 years old, and have been remunerative. It has been fertilized with lime, marl, potash and bone, and has received good cultivation.

Dr. Henry Race, of Pittstown, Hunterdon county, who has used potash salt and bone for the past six years, writes: "In my experience, if trees bear an excessively large crop they are liable to an unhealthy appearance; the leaves turn yellow; small, reddish shoots start up from the large branches near the trunk, and the wood soon becomes of a dark, brownish color. Whether these symptoms represent the specific disease called the 'yellows,' or not, muriate of potash and superphosphate of lime, applied as soon as the crop is gathered, in the quantity of 400 or 500 pounds to the acre, with good cultivation and pruning, will prevent this premature decay, or arrest it if just commenced. If the fertilizer is withheld till the wood has become dark brown, its application may improve the appearance of the tree, but it will never become healthy and vigorous again."

From the experience and practice of the most successful peach growers, we arrive at the following conclusions, viz.: That for successful peach culture the soil must be adapted to the development of the tree and fruit, properly located and drained. Then acting upon the principle that it is better to prevent than cure disease, perfectly healthy trees should be selected for planting, and after being planted they should be thoroughly cultivated, judiciously pruned and well nourished with the proper amount of food best suited to their healthy growth and productiveness.

NITROGE

THE EXAMINATION AND COMPARISON OF
FOR THE DETERMINATION OF

The Kjeldahl method for the determinatio
free from nitrates, was introduced into the
the season of 1885.

The re-agents and apparatus used were, wit
same as described in a review of the met
Zeitg. VIII., 432.

The difficulties encountered then were—
cases, to secure complete oxidation in a reas
the serious bumping of the solution on bo
or soda.

The past season certain changes in the m
by other chemists, were observed.

The method as now used is practically ide
in the Proceedings of the Third Annual Co
tion of Agricultural Chemists, pages 53–4–5

No difficulty was experienced in oxidizing
stance in from one to three hours; when ca
the digestion until a perfectly colorless so
addition of potassium permanganate did n
absence also seemed to lessen the liability o
When caustic soda was used the boiling wa
caustic potash, however, the bumping of th
to make it difficult to finish the determinatio

It is absolutely necessary to thoroughly tes
sulphuric acid and caustic soda oftentimes co
or nitrates. Throughout the year, in all c
method was applicable, duplicate determinati

were carried out. A comparison of the results warrants the following conclusions:

The average determinations of one hundred and twenty samples of complete fertilizers show that the higher percentages of nitrogen were secured by the Kjeldahl process; the average difference for the whole number of samples between the results from these two methods is five hundredths of one per cent.

Of the twenty-five samples of high grade organic nitrogenous material analyzed, the average percentage of nitrogen is identical by both methods.

In ground bones, dissolved bones and miscellaneous materials, the average determinations of twenty-seven samples by Kjeldahl's method were seven hundredths of one per cent. lower than by soda-lime process.

The Kjeldahl method secured slightly higher percentages of nitrogen in coarse fodder samples.

A comparison of the determinations made are tabulated below.

Station number.	BRAND.	Per cent. of Nitrogen, Soda-Lime.	Per cent. of Nitrogen, Kjeldahl.	Station number.
1250	Rose Bone Fertilizer	0.31	0.32	1250
1251	Selected Esmeralda	3.85	3.88	1251
1255	Doughten's Ammoniated Superphos	2.95	2.97	1255
1257	" Potato Manure	3.10	3.14	1257
1260	Planet Phosphate	1.38	1.48	1260
1266	Bowker's Hill and Drill Phosphate	2.31	2.32	1266
1268	Star Bone Phosphate	1.99	2.00	1268
1272	Stearn's Eagle Brand	1.40	1.48	1272
1274	Bradley's Superphosphate of Lime	3.10	2.98	1274
1278	Yarnell's Ammoniated Phosphate	1.01	1.12	1278
1279	" Fish	1.54	1.52	1279

Station number.	BRAND.	Per cent. of Nitrogen, Soda-Lime.	Per cent. of Nitrogen, Kjeldahl.	Station number.
1281	Yarnell's High Grade Potato Manure	2.78	2.90	1281
1282	" Bone	2.57	2.59	1282
1283	W. & C. Superphosphate	1.97	1.87	1283
1286	National Complete Fertilizer	1.09	1.17	1286
1287	" Potato Fertilizer	1.47	1.54	1287
1288	" Tobacco "	1.22	1.32	1288
1293	Moro Phillips' Superphosphate	1.82	1.92	1293
1294	" " Phuine	2.25	2.22	1294
1301	Clark's Cove Unicorn	2.40	2.39	1301
1311	Lister's Potato Manure	4.72	4.82	1311
1312	Coe's High Grade Ammoniated Bone	2.06	2.18	1312
1315	" Red Brand Potato Manure	3.57	3.68	1315
1318	Ralston's Knickerbocker	2.12	2.22	1318
1319	" Ammoniated Bone Phosphate	1.82	1.89	1319
1320	" Potato Fertilizer	1.69	1.73	1320
1332	Taylor's Complete Fertilizer	2.93	2.96	1332
1339	Gaskill's Special Fish	2.12	2.06	1339
1341	Virginius Guano	3.83	3.81	1341
1342	Taylor's Complete Fertilizer, all crops	2.85	2.94	1342
1345	National Superphosphate	1.16	1.10	1345
1346	Bowker Fish and Potash	2.29	2.37	1346
1353	Allen's Complete Phosphate	1.72	1.76	1353
1354	" Special Fertilizer	1.69	1.73	1354
1355	" Potato and Truck Manure	3.40	3.51	1355

Station number.	BRAND.	Per cent. of Nitrogen, Soda-Lime.	Per cent. of Nitrogen, Kjeldahl.	Station number.
1357	Coe's Alkaline Bone	1.39	1.45	1357
1358	Baker's Complete Potato Manure	3.89	3.98	1358
1359	Taylor's Ammoniated Dissolved Bone and Potash	1.78	1.88	1359
1360	" Complete Fertilizer for Corn and Truck	2.44	2.38	1360
1364	Smith's Standard Grain and Grass Phosphate	2.89	3.03	1364
1367	Coe's Peach Tree Manure	1.57	1.59	1367
1368	Acme Fertilizer	4.44	4.62	1368
1370	Baker's Special Oat Manure	4.55	4.45	1370
1371	Formula A, Great Planet	4.81	4.83	1371
1373	Smith's Potato and Truck Fertilizer	3.10	3.17	1373
1376	Walton & Whann's Plow Brand	2 36	2.47	1376
1379	Queen City Phosphate	1.86	1.92	1379
1381	Baker's Fruit Tree Manure	1.80	1.92	1381
1385	Arlington B. for all Crops	2.08	2.18	1385
1388	Alpha Soluble Bone and Potash	0.07	0.16	1388
1392	Potato Manure	3.02	2.99	1392
1394	Cooke's Blood Guano	2.65	2.62	1394
1397	Dissolved Bone	1.57	1.64	1397
1398	Chittenden's Universal Phosphate	2.68	2.70	1398
1400	10 Per Cent. Guano	8.83	8.88	1400
1401	Preston's Potato Fertilizer	3.40	3.50	1401
1404	Baker's Onion Manure	4.19	4.28	1404
1405	" Strawberry Manure	2.66	2.77	1405
1409	Granger Fertilizer	2.06	2.06	1409

Station number.	BRAND.
1410	Stockbridge Potato Manure......
1412	Acidulated Fish Guano............
1415	Bone Phosphate.....................
1421	Gaskill's High Grade Manure...
1423	Ammoniated Bone Superphospl
1425	Potato Fertilizer......... ....
1433	Bowker's Ammoniated Bone P
1434	Soluble Pacific Guano............
1436	Gaskill's Popular Phosphate....
1440	Mitchell's Complete Manure....
1441	Potato Fertilizer..................
1443	Coe's XXV. Phosphate...........
1447	Swift Sure $23 Phosphate.......
1448	Bowker's Ammoniated Superpl
1451	Cereal Fertilizer....................
1452	Lister's Success....................
1458	" Ammoniated Dissolved
1459	" U. S. Superphosphate..
1462	Royal Bone.........................
1466	Ammoniated Dissolved Bone w
1472	A. A. Ammoniated Superphosı
1473	Pelican Bone Fertilizer..........
1477	Lofland's Button Bone Fertiliz
1479	Sardy's Phospho Peruvian Gua

Station number.	BRAND.	Per cent. of Nitrogen, Soda-Lime.	Per cent. of Nitrogen, Kjeldahl.	Station number.
1482	Soluble Tampico Guano	2.12	2.17	1482
1484	Ammoniated Bone Superphosphate	2.84	2.96	1484
1493	Raw Bone Superphosphate	0.94	1.08	1493
1497	Bay Side Fertilizer	1.69	1.76	1497
1499	Potato Compound	2.98	3.10	1499
1502	Prime Esmeralda Guano	1.52	1.58	1502
1505	Clark's Cove King Philip	1.50	1.57	1505
1507	Baker's Corn Manure	4.62	4.73	1507
1509	Ocean Guano	2.08	2.08	1509
1510	Allen's Nitro Phosphate	1.99	2.02	1510
1511	" Marine Guano	4.02	4.08	1511
1512	" Popular Phosphate	0.67	0.80	1512
1516	Bone Phosphate, No. I	1.03	1.12	1516
1521	Chittenden's Ammoniated Bone Superphos	2.53	2.48	1521
1522	" Complete Fertilizer	4.26	4.33	1522
1523	Buffalo Ammoniated Bone Superphosphate	3.68	3.75	1523
1524	Wheat, Corn and Oats Fertilizer	1.82	1.87	1524
1526	Clark's Cove Bay State	3.00	3.05	1526
1530	Lister Bros.' Corn Manure	4.26	4.28	1530
1532	" " Superphosphate of Lime	2.54	2.57	1532
1534	Depue's High Grade Bone Superphosphate	1.56	1.68	1534
1537	Bone, Animal Matter, Kainit, etc	0.35	0.42	1537
1543	Vegetable Bone Superphosphate	5.07	5.15	1543
1546	Potato, Hop and Tobacco	2.31	2.43	1546

Station number.	Brand.
1549	Ammoniated Bone Superphosphate...
1551	Preston's Corn Fertilizer................
1558	Coe's Ammoniated Bone Superphosp
1559	" Excelsior Guano.....................
1561	Delta ....
1567	Stockbridge Manure for Corn...........
1568	Union County Fertilizer.................
1569	Normal No. 1 Phosphate.................
1573	Echo Superphosphate.....................
1582	Allen's Dried and Ground Fish........
1586	Chittenden's Fish and Potash..........
1587	Bradley's Potato and Vegetable Man
1588	Stearn's Ammoniated Bone............
1591	Forrester's Potato Manure..............
1595	Griffing's Superphosphate...............
160	Russel Coe's Ringoes Fertilizer........

HIGH GRADE NITROGENOUS MATERIALS.

Station No.	Brand.	Per cent. of Nitrogen, Soda-Lime.	Per cent. of Nitrogen, Kjeldahl.	Station No.
1138	Tankage	7.88	7.88	1138
1139	Dried Blood	14.21	14 26	1139
1148	Tankage	6.55	6.40	1148
1149	Dried Blood	10.02	10.11	1149
1158	Castor Pomace	4.71	4.68	1158
1167	Tankage	9.12	9.11	1167
1173	Hoof Meal	15.11	15.05	1173
1174	Tankage	8.71	8.55	1174
1176	Dried Ground Fish	9.12	9.05	1176
1186	Dried Blood	9.49	9.42	1186
1187	Prepared Blood and Animal Matter	6.44	6.35	1187
1195	Western Tankage (Hog)	6.07	6.11	1195
1196	Tankage Beef	3.31	3.35	1196
1197	Tankage (Hog)	4.88	4.93	1197
1201	Dried Blood	11.02	10.92	1201
1202	Ammonite	11.87	11.93	1202
1203	Tankage	3.09	3.19	1203
1204	Dried Ground Fish	8.52	8.50	1204
1212	Ammonite B	11.99	12.08	1212
1213	Swift Sure Guano	7.95	7.88	1213
1222	Ammonite	11.99	11.98	1222
1227	Azotine (Pork)	12.17	12.08	1227
1228	Dried Ground Fish	8.53	8.61	1228
1234	Tankage	6.11	6.14	1234
1241	A. A. Nitrogen	10.46	10.50	1241
1248	Dried and Ground Fish	8.34	8.34	1248

Station number	BRAND.	Per cent. of Nitrogen, Soda Lime.	Per cent. of Nitrogen, Kjeldahl.	Station number.
1271	Ground Bone	4.09	4.00	1271
1308	" "	3.86	3.74	1308
1337	" "	3.91	3.87	1337
1349	" "	2.91	2.86	1349
1426	" "	5.62	5.55	1426
1427	" "	6.36	6.23	1427
1429	" "	1.64	1.55	1429
1457	" "	3.98	3.90	1457
1470	" "	3.37	3.32	1470
1492	" "	3.93	3.82	1492
1494	" "	3.95	3.83	1494
1518	" "	4.12	3.95	1518
1519	" "	1.73	1.67	1519
1527	" "	4.16	4.07	1527
1533	" "	4.00	3.90	1533
1538	" "	3.68	3.61	1538
1553	" "	4.18	4.09	1553
1579	" "	4.30	4.17	1579
1597	" "	1.64	1.76	1597
	MISCELLANEOUS.			
1350	Dried and Ground Fish	5.66	5.55	1350
1395	Rotted Bone Manure	2.59	2.50	1395
1539	Ammoniated Bone	2.43	2.31	1539
1562	" Dissolved Bone	1.97	1.94	1562
1578	$25 Phosphate	2.47	2.37	1578
1581	Dry Fish Scrap, California	9.92	9.94	1581
1582	Dried and Ground Fish	2.89	2.78	1582
1446	Ammoniated Dissolved Bone	1.55	1.48	1446

FODDERS.

Station number.	BRAND.	Per cent. of Nitrogen, Soda Lime.	Per cent. of Nitrogen, Kjeldahl.	Station number.
338	Lucern	2.97	2.96	338
341	Clover	2.02	2.08	341
342	Lucern, 2d Cut	2.72	2.81	342
343	Hungarian Millet	0.93	0.99	343
344	Clover, 2d Cut	2.18	2.21	344
345	Hungarian Millet Seed	1.45	1.59	345
347	Lucern, 3d Cut	2.30	2.40	347
350	Corn Stalks	1.34	1.35	350
352	Hungarian Grass Hay	1.36	1.47	352
354	Buckwheat Straw	1.20	1.24	354
355	Oil Cake Meal	5.99	6.11	355
387	Orchard Grass Hay	0.98	1.06	387
391	Oat Straw	0.43	0.51	391
394	Timothy Hay	0.77	0.82	394
405	Bog Hay	1.04	1.02	405
410	Wheat Straw	0.43	0.47	410
411	Corn Stalks	0.54	0.55	411
417	Rye Straw	0.48	0.48	417
418	Creek Sedge	0.52	0.51	418
425	Timothy Hay	0.60	0.53	425
430	German Millet	0.75	0.73	430
431	Timothy Hay	0.75	0.73	431

APPEN

ACT OF INCOR

The New Jersey Agricultural Exp
by authority of the following acts of

CHAPTER

AN ACT TO PROVIDE FOR THE E
CULTURAL EXPERIM

1. **Be it enacted** *by the Senate*
State of New Jersey, That for the be
agriculture, and for the development
New Jersey Agricultural Experiment
is hereby established.

2. *And be it enacted*, That the dire
institution shall be committed to a B
consist of the Governor of the State,
State Agricultural College, together w
fessor of Agriculture of that institutio

3. *And be it enacted*, That the me
called together by the Secretary of th
organize by the election of a Presid
hold their offices for one year and unt
five members shall constitute a quorum

4. *And be it enacted*, That the Bo
meeting each year, at Trenton, on the t
other meetings at the call of the Presi
as may best promote the objects of the

5. *And be it enacted*, That the Boar

Experiment Station and branches, and shall appoint a Director, who shall have the general management and oversight of the experiments and investigations necessary to carry out the objects of said institution, and shall employ competent chemists, and other assistants necessary to analyze soils, fertilizers and objects of agricultural interest, so as to properly carry on the work of the Station, and it shall make an annual report of its work to the Governor of the State.

6. *And be it enacted,* That a sum not exceeding five thousand dollars in any one year is hereby appropriated to said New Jersey Experiment Station, which money shall be paid out from the State Treasury on the presentation of the bills of said Station, properly certified by the President and Secretary of the Board of Directors.

7. *And be it enacted,* That this act shall take effect immediately.

Approved March 10th, 1880.

CHAPTER LXXXI.

A SUPPLEMENT TO THE ACT ENTITLED "AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF AN AGRICULTURAL EXPERIMENT STATION," APPROVED MARCH TENTH, ONE THOUSAND EIGHT HUNDRED AND EIGHTY.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey,* That from and after the passage of this act, the Board of Directors, mentioned and created by said act, shall be called and known as the Board of Managers.

2. *And be it enacted,* That in addition to the powers now conferred upon said Board, they shall have power to elect a Treasurer, who shall hold his office for one year and until his successor shall be elected and qualified; and to appoint such other officers and agents as may be necessary to carry on the business of the institution; and to make such rules, by-laws and regulations for the government of the Board, and for carrying out the objects, business and purposes of the institution, as may, in their judgment, be necessary and proper.

3. *And be it enacted,* That the annual appropriation for the support of the New Jersey Agricultural Experiment Station be and the same is hereby increased from its present sum of five thousand dollars a year to eight thousand dollars a year.

4. *And be it enacted,* That this act shall take effect immediately.

Approved March 9th, 1881.

A SUPPLEMENT TO THE SUPPLEMENT TO AN ACT ENTITLED "AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF AN AGRICULTURAL EXPERIMENT STATION," APPROVED MARCH NINTH, ONE THOUSAND EIGHT HUNDRED AND EIGHTY-ONE.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey,* That section three of the supplement to the act entitled "An act to provide for the establishment of an Agricultural Experiment Station," be amended so as to read as follows:

3. *And be it enacted,* That the expenses of said Station, when presented to the Comptroller of the State, accompanied by the proper vouchers, duly certified by the President and Secretary of the Board of Directors, shall, upon warrant of said Comptroller, be paid out of the State Treasury; *provided,* such expenses do not exceed the sum of eleven thousand dollars in any year.

2. *And be it enacted,* That this act shall take effect immediately.

Approved May 9th, 1884.

◆

LAWS OF NEW JERSEY.

AN ACT TO REGULATE THE MANUFACTURE AND SALE OF FERTILIZERS.

1. That every commercial fertilizer which shall be offered for sale in this State shall be accompanied by an analysis, stating the percentage therein of ammonia, or its equivalent of nitrogen; of potash, in any form or combination, soluble in distilled water; and of phosphoric acid in any form or combination; the portion of phosphoric acid soluble in distilled water; that portion soluble in a neutral solution of citrate of ammonia at a temperature not exceeding one hundred degrees Fahrenheit; and that portion of phosphoric acid not soluble in either of the above-named fluids, shall each be determined separately; and the material from which the phosphoric acid is obtained shall also be stated; a legible statement of such analysis

shall accompany all packages or lots of over one hundred pounds, sold, offered or exposed for sale.

2. That the Chemist of the State Board of Agriculture shall be the Inspector of Fertilizers; it shall be his duty to analyze one or more samples of every kind of commercial fertilizers coming within the provisions of this act, which may be offered for sale within the State, and of which he shall be informed.

3. That manufacturers, dealers, and all persons interested, may obtain an analysis by notifying the Chemist of the State Board of Agriculture, upon which notification he shall be authorized to analyze, at his discretion, samples selected by himself, and to furnish certified copies of such analysis to the persons on whose application they were made; and it shall also be his duty to report all such analyses to the State Board of Agriculture.

4. That the Chemist of the State Board of Agriculture shall receive for each certificate of analysis made by him a sum not to exceed fifteen dollars, to be paid by the person or persons applying therefor.

5. That any person selling, offering or exposing for sale any commercial fertilizer without the analysis required by the first section of this act, or with an analysis stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense.

Approved March 24th, 1874.

SUPPLEMENT.

SEC. 1. That the penalty or penalties prescribed in section five of that act may be sued for and recovered, in an action of debt, in any court of competent jurisdiction in this State, in the name of any person who will sue for the same, one-half thereof for his own use, and the other half to be paid to the county superintendent of public schools of the county in which such suit or suits shall be brought, for the use of the public schools in their county.

Approved March 31st, 1875.

DIRECTIONS TO BE FOLLOWED IN SAMPLING FERTILIZERS.

Inspectors may sample fertilizers found either

1—upon farms,
2—in dealers' storehouses, or,
3—in manufactories.

The Station prefers that samples should be drawn either upon farms or in dealers' storehouse.

In sampling fertilizers found upon farm, inspectors should ascertain,

1st, that the farmer has received these fertilizers *during the present season,*

2d, that they were received in good condition; and have since been so stored that a noticeable gain or loss of moisture has been prevented.

In no case should farm samples be taken from stock of a past season or from stock which is or has been carelessly stored.

In sampling from *dealers' storehouses,* inspectors should also ascertain whether the fertilizers are of old (last season's) or of new stock. Preference should always be given to the present season's goods. Circumstances may, however, make it advisable to sample old stock; in such cases, this fact must be distinctly stated by the inspector, in his report to the Station's Director.

If for any reason it is found to be necessary to draw samples at factories, inspectors should decline,

1st, to sample from piles of fertilizers;

2d, to sample from bags which are not distinctly marked with the brand, the manufacturer's name and the guaranteed analysis.

If fertilizers are found stored in piles only, inspectors should cause six or more bags to be filled from different portions of the piles; from these bags the samples may be drawn in the usual manner.

SAMPLING.

Whenever the mechanical condition will allow samples should be drawn by means of the *sampling tube.*

This tube is formed to a sharp point at one end, and can be forced to the bottom of a bag or barrel. A slot extending nearly its entire length can then be opened and the tube allowed to fill with the fertilizer. When the slot is closed and the tube withdrawn, it will contain a fair sample of any given package.

It is not desirable to sample lots of less than one-half ton of any one brand. In such lots portions may be taken from each bag; in larger lots each fifth or tenth bag may be opened. The several portions representing the same brand should then be carefully mixed and a quart fruit jar filled, securely closed and marked with labels furnished by the Station.

As soon as a sample has been taken, and *invariably* before bags of another have been opened, the inspector should carefully filled out the blank describing samples.

He should copy *from the bags,*

1st, the brand,
2d, the name of the manufacturer,
3d, the guaranteed analysis.

Any other information desired can be sought from the owner of the fertilizer.

Each sample bottle should be carefully wrapped in heavy paper, and packed for transportation in a wooden box, properly closed. This box should be forwarded by express, directed to

THE NEW JERSEY AGRICULTURAL EXPERIMENT STATION,
GEORGE H. COOK, DIRECTOR,
New Brunswick, N. J.

FORM FOR DESCRIPTION OF SAMPLE.

The person sending samples to the Station for analysis without charge, will be provided with a form like this for each sample, and must fill up every one of the blank particulars given, so as to make the description complete and definite, and in every case write his signature, as endorsing the accuracy of it. As there is much responsibility in taking fair average samples, such as will justly represent the manufacturer as well as the consumer, it is very important that every precaution be taken, so that in case of a suit at law the person signing the description can testify to its accuracy. The writing should be plain and legible. The filled out form, if wrapped with the sample, will serve as a label. If any printed circular, pamphlet, analysis or statement accompanies the fertilizer, or is used in its sale, send a copy with the specimen.

1. *Brand of Fertilizer*..

2. *Name and address of Manufacturer*..

....

3. *Name and address of Dealer from whose stock this sample is taken*..............

....

4. *Date of taking this sample*..

5. *Selling price per ton, hundred, bag or barrel*...................................

6. *Selling weight claimed for each package weighed*...............................

7. *Actual weights of packages opened*...

8. *Copy of analysis or composition affixed to packages of this Fertilizer*..........

....

....

....

9. *Signature of person taking sample*..

P. O. Address..

FODDERS AND FEEDS.

FORM FOR DESCRIPTION OF SAMPLE.

The person sending samples to the Station for analysis without charge, will be provided with a form like this for each sample, and must fill up every one of the blank particulars given, so as to make the description complete and definite, and in every case write his signature, as endorsing the accuracy of it. As there is much responsibility in taking fair average samples, such as will justly represent the manufacturer as well as the consumer, it is very important that every precaution be taken, so that in case of a suit at law the person signing the description can testify to its accuracy. The writing should be plain and legible. The filled out form, if wrapped with the sample, will serve as a label. If any printed circular, pamphlet, analysis or statement accompanies the sample, or is used in its sale, send a copy with the specimen.

1. *Brand of Fodder or Feed* ....

2. *Name and address of Manufacturer*..

....

3. *Name and address of Dealer from whose stock this sample is taken*..............

....

4. *Date of taking this sample*..

5. *Selling price ton, hundred, bag or barrel*..

6. *Selling weight claimed for each package weighed*..

7. *Actual weights of packages opened*..

8. *Copy of analysis or composition affixed to packages of this sample*..................

....

....

....

9. *Signature of person taking sample*..

P. O. Address..

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